



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

AN AMERICAN
GEOLOGICAL RAILWAY GUIDE

MACFARLANE

AN AMERICAN
GEOLOGICAL RAILWAY GUIDE

MACFARLANE

H. W. TURNER.

LIBRARY.



557.3

M143

ed. 2 ✓

LIBRARY
OF THE
UNITED STATES
AN AMERICAN
UNIVERSITY
GEOLOGICAL RAILWAY GUIDE

GIVING THE
GEOLOGICAL FORMATION AT EVERY RAILWAY STATION
WITH
ALTITUDES ABOVE MEAN TIDE-WATER,

NOTES ON INTERESTING PLACES ON THE ROUTES
AND
A DESCRIPTION OF EACH OF THE FORMATIONS

BY
JAMES MACFARLANE, PH. D.,
AUTHOR OF "THE COAL-REGIONS OF AMERICA," AND ONE OF THE COMMISSIONERS OF
THE SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA,

WITH THE CO-OPERATION OF THE STATE GEOLOGISTS, AND OTHER SCIENTIFIC GENTLEMEN.

SECOND EDITION, REVISED AND ENLARGED,

EDITED BY
JAMES R. MACFARLANE.

NEW YORK:
D. APPLETON AND COMPANY,
1, 3, AND 5 BOND STREET.

1890.

1. **Yanvar**
 2. **Fevral**
 3. **Mart**
 4. **Apr**
 5. **May**
 6. **Yun**
 7. **Yul**
 8. **Av**
 9. **Sent**
 10. **Okt**
 11. **Nov**
 12. **Dek**

COPYRIGHT, 1878, 1885,
BY JAMES MACFARLANE.
1890,
BY JAMES R. MACFARLANE.

425286

GIES & CO.,
BUFFALO, N. Y.,
PRINTERS,
1890.

PREFACE TO THE SECOND EDITION.

The first edition of this book was published by my father, the late James Macfarlane, in 1878 and, at the time of his death in October, 1885, he had prepared many of the chapters and collected some of the material for others for this second edition. By following the system of the work already completed, with the assistance of the gentlemen whose names appear throughout these pages, I have, after many delays, completed the edition.

The whole book has been carefully revised and new lines and new notes added, so that the Guide, proper, has been enlarged from 158 to 370 pages. The introductory portion of the book has been changed only where necessary to conform its statements to the views now held by geologists. The altitudes are a new and valuable feature of this edition and the list is as complete as could be obtained. A few chapters were so prepared by their authors that little work was needed before printing them, but in most instances the labor of collecting and arranging such a mass of material into a compact and harmonious form has been greater than would be imagined. Whatever defects and mistakes are found in the book may be attributed to the loss of the one whose mind conceived its plan, and who was peculiarly fitted for its preparation.

To the contributors and my many advisors I owe a debt of gratitude that I cannot express, but I know that they will feel rewarded if their work results in an increase of interest in, and knowledge of, the noble science of geology.

JAMES R. MACFARLANE.

Pittsburgh, Pa., 1890.

TABLE OF CONTENTS.

	PAGE.		PAGE.
Objects and Uses of the Work	3	Geological Railway Guide.	
Dana's Table of Formations	6	Canada	51
Hunt's " "	7	The New England States	85
Combined " "	8	Table of New England Formations	86
Descriptions of the Formations.	9	Maine	87
1 a. Laurentian	10	New Hampshire	89
1 b. Norian	11	Vermont	92
1 c. Arvonian	12	Connecticut	94
1 d. Huronian	12	Massachusetts and Rhode Island	99
1 e. Montalban	13	New York	109
1 f. Taconian	13	New Jersey	139
2 a. Acadian	14	Pennsylvania	151
2 b. Potsdam	14	Ohio	177
3 a. Calciferous	16	Michigan	189
3 b. Chazy	16	Indiana	198
3 b. St. Peter's	17	Illinois	209
4 a. Trenton	17	Wisconsin	223
4 b. Utica	19	Iowa	233
4 c. Hudson River or Cincinnati	19	Minnesota	246
Keweenaw	21	North and South Dakota	253
5 a. Medina	22	Note on Geology of the West	257
5 b. Clinton	23	Northern Pacific	258
5 c. Niagara	24	Montana and Washington	264
6. Salina	25	Missouri	267
7. Lower Helderberg	28	Kansas	274
8. Oriskany	28	Nebraska	293
9. Upper Helderberg, or Corniferous	29	Colorado	297
9 a. Canda Galli	29	Wyoming	309
9 b. Schoharie Grit	29	Utah	309
9 c. Onondaga	29	Idaho	309
9 d. Corniferous	30	Nevada	309
10 a. Marcellus	30	Oregon	316
10 b. Hamilton	31	California	318
10 b. Tully Limestone	32	Delaware	329
10 c. Genesee	33	Maryland	332
11 a. Portage	34	West Virginia	337
11 b. Chemung	35	Virginia	352
12. Catskill	36	North Carolina	365
13 a. Lower Sub-Carboniferous	37	South Carolina	369
13 b. Upper Sub-Carboniferous	38	Georgia	374
14 a. Millstone Grit	39	Alabama	378
14 b. & c. Lower and Upper Coal Measures	39	Mississippi	386
15. Permian	40	Louisiana	390
16. Triassic	41	Florida	392
17. Jurassic	43	Kentucky	395
18. Cretaceous	43	Tennessee	401
19. Tertiary	44	Arkansas	406
20. Quaternary	45	Indian Territory	408
Remarks on the Descriptions	49	Texas	409
Directions for Using the Guide	53	Mexico	415

THE OBJECTS AND USES OF THIS WORK.

1. FOR THOSE WHO ARE NOT GEOLOGISTS.

The United States are intersected by numerous railroads leading in all directions, and nearly every one has occasion more or less to travel on them for considerable distances. In these railway journeys no person who has the least power of observation can fail to notice the peculiarities in the scenery and the great variety in the formations of rock to be seen in the railway cuts and cropping out on the hillsides. If we always had a professor of geology for our traveling companion, we would be glad to learn from him what these various formations of rock are, what place they occupy in the series of strata that are visible on the earth's surface, and their mineral and other productions; also at what other localities the same rocks occur, and whether they are entirely new to us or the same we have seen elsewhere. This work is a substitute for the supposed traveling professor of geology, giving in a small space the names of the geological formations which occur along the lines of the railroads, and in another part of the book is to be found a plain but full description of each of them. There are also foot notes directing attention to interesting geological places and objects on the routes of the railroads. One object of the work is to teach persons not versed in geology something of this science during the tedious and unprofitable hours of traveling, without study, not as in a text book, but by pointing to the things themselves as seen at railway stations and through the windows of a railway car.

No person could be so stupid as to travel all over the United States without learning the name of a single state or city through which he passes, yet how few persons know even the names of the geological formations on which they have spent their lifetimes. Every one is taught geography, and there is scarcely a child of sufficient age who cannot tell the name of the town, county and state in which he lives. But geology, which is just as well worth knowing, is neglected, and there is but little opportunity for learning any thing practically in regard to it from those about us. This is not owing to a want of a desire for knowledge, but to a want of instruction in this science, and of the practical application of what is learned by adding local geological information in a handy, cheap and accessible form, and this, which no other work affords, it is the aim of this book to furnish.

There are some kinds of knowledge too that cannot be obtained from books, but must be gathered by actual observation. The inspection of a formation in nature, which is pointed out to you, will teach you more in regard to it in a few minutes than you could learn from lectures or from reading books in as many hours, and the lesson so received will be better remembered. This book is intended as an intelligent guide to such observations. It tells you where the various formations are, and you can then see for yourself in traveling what they are.

How lonely would be a journey on which you would see not a single face that you know, and how different it would be if every one you meet were an old friend. So to the tourist new charms must be given to scenery, however attractive it may already be, if he knows something about its geology. The rocks, mountains, valleys and plains, although he sees them for the first time, are old friends in perhaps new and interesting forms. He meets them with a certain pleasure, for he understands what he sees and he is given the materials for many a happy hour of quiet and profitable reflection at home, on what he has seen on his railway journey.

2. FOR GEOLOGISTS.

But while the book is thus intended primarily as a series of object lessons for those to whom geology is yet a novelty, for the purpose of exciting an interest in, and which may ripen into a love for the science, it is believed that, being in a more convenient form than geological maps, and as no other work has attempted what is here done, all geologists, and especially students, will find it a most useful hand book on their railway journeys as well as for reference at home. It will be useful in laying down the geology in colors on any map which gives the railroads. Accurate geological maps can thus be made without expense, and there is no better exercise for students. It will also be invaluable in selecting a route of travel for geological study or for pleasure, and no geologist should make an excursion over new ground without this guide. It is a scientific catalogue of the great panorama that passes with its ever shifting scenery before the eyes of the American railway traveler, and even an artist finds a catalogue of a picture gallery very necessary. No geologist need be told that it embraces the result of a vast amount of learning, labor and research in a very small compass, and a minuteness of local geology for which he might ransack libraries in vain, and which no one man could possibly furnish. Many men for many years have devoted the finest talents in America to the study of the geology of these states, and all have contributed by their published reports, or by direct original contributions to this work, portions of the knowledge which is here indexed, otherwise it would not be becoming for the author to say so much in its praise. In order that the guide might be as accurate as possible the assistance of the state geologist of each state, or that of some scientific gentleman best acquainted with its local geology, has been invoked to revise and correct the list of formations found along the railroads. Without a single exception, and with characteristic devotion to the cause of science,* this aid has been very cheerfully and promptly rendered, and in not a few instances, where the necessary information was only in the knowledge of these gentlemen, they have filled in the geology from original sources not yet published. Due credit is given to all contributors in the notes of the proper chapter. The general accuracy of the book can be relied upon as to the formations of each locality as they were understood at the time of its publication, and it may be regarded as in harmony with the latest results of geological research. If errors are found, consider the great number of railroad stations and you will wonder there are so few.

**Scientific men freely give the results of their labors to the world, expecting only in return to enjoy the consciousness of having added by their investigations to the sum of human knowledge, and to receive the credit to which they might justly entitle them.* PROF. JOSEPH HENRY.

3. FOR USEFUL, PRACTICAL PURPOSES.

To those who take only utilitarian views and care nothing for pure science, and to all those in any way interested in the country, a means is here furnished for ascertaining the natural advantages or disadvantages of any district where there is a railroad, for it is now pretty well known to all intelligent persons that the capabilities or resources of a country, what it is and what it can become, depend chiefly on its geology.

No one in our day can doubt, that there is a definite and orderly arrangement of the rocks, that it is only in certain rocks that certain useful materials and minerals are to be obtained, and that the soil of each formation has a certain fixed value for agriculture. It was long ago shown that a geological map of England, is a map also of the distribution of its manufactures. Even the kind of people inhabiting a district, often depends on its geology. A considerable portion of the work of geologists, is devoted to tracing out the distribution of the various formations as they come out from beneath one another, and spread over the face of the country. This book is made up of a minute tabular statement or division of all places on the American railways, into classes, some of which yield useful materials or productions peculiar to them. It points out the limits to be observed in searching out new locations producing any material. Besides, if accompanied by a correct scientific knowledge of the country, it will make any man's discovery of anything useful available to his neighbors in hundreds of other places, over the whole region covered by the same formation.

The physical structure of a country being then, the means by which we can learn the range and distribution of useful materials, a strict attention to fossils is necessary, to enable us to determine the relative position of rock groups, each group, within certain limits, holding its own peculiar fossil forms, and certain economic products being confined, over wide areas, either wholly or principally to certain rocks. Many persons, ignorantly confounding the means with the end, think geologists are good authorities upon fossils, but not as to the useful properties of the formations. Sir William E. Logan, the great Canadian geologist, in answer to this objection, once said: "I am not a naturalist; I do not describe fossils, but use them. They are the geologist's friends, who direct him in the way to what is valuable. To get the necessary information from them, you must be able to recognize their aspect, and in order to state your authority, you must give their names. Some of them tell of coal—they are cosmopolites; while some give local intelligence of gypsum, or salt, or building stone. One of them helped us last year to trace out, in Canada, upwards of fifty miles of hydraulic limestone."

But it is not practicable for ordinary readers to understand the difficult science of paleontology; all they can expect to know are the results as ascertained by professional geologists, and those results are given in this little book, for every place on every railroad in America. There are many other things that might have been given, especially the structural geology of each State, geological maps, more minute lists of elevations and general physical geography, but the book contains enough for one little volume to be carried about on railway journeys.

**Prof. J. D. Dana's Table of the Geological Formations (1885),
AS NUMBERED IN THE GEOLOGICAL RAILWAY GUIDE.**

Systems or Ages.	GROUPS OR PERIODS.	FORMATIONS OR EPOCHS.
20. Age of Man.	20. QUATERNARY.	20 Quaternary.
19. Age of Mammals.	19. TERTIARY.	19 c. Pliocene. 19 b. Miocene. 19 a. Eocene.
16-18. Reptilian Age.	18. CRETACEOUS.	18 c. Upper Cret. 18 b. Middle Cret. 18 a. Lower Cret.
	17. JURASSIC.	17 Jurassic.
	16. TRIASSIC.	16 Triassic.
13-15. Carbonifer- ous.	15. PERMIAN.	15 Permian.
	14. CARBONIFEROUS.	14 c. Upp. Coal-meas. 14 b. Low. Coal-meas. 14 a. Millstone Grit.
	13. SUBCARBONIFEROUS.	13 b. Upper Subcarb. 13 a. Lower Subcarb.
8-12. Devonian, or Age of Fishes.	12. CATSKILL.	12 Catskill.
	11. CHEMUNG.	11 b. Chemung. 11 a. Portage.
	10. HAMILTON.	10 c. Genesee. 10 b. Hamilton. 10 a. Marcellus.
	9. CORNIFEROUS.	9 c. Corniferous. 9 b. Schoharie. 9 a. Cauda Galli.
	8. ORISKANY.	8 Oriskany.
	7. LOWER HELDERBERG.	7 Lower Helderberg
2-7. Silurian, or Age of Invertebrates. 2-4. Lower Silurian. 5-7. Upper Silurian.	6. SALINA.	6 Salina.
	5. NIAGARA.	5 c. Niagara. 5 b. Clinton. 5 a. Medina.
	4. TRENTON.	4 c. Hudson River. 4 b. Utica. 4 a. Trenton.
	3. CANADIAN.	3 b. Chazy. 3 a. Calciferous.
	2. PRIMORDIAL OR CAMBRIAN.	2 b. Potsdam. 2 a. Acadian.
	1. ARCHÆAN.	1 b. Huronian. 1 a. Laurentian.

Table of the Geological Formations,

ARRANGED FOR THE SECOND EDITION OF THIS WORK BY T. STERRY HUNT, LL. D., F. R. S.

AGES.	GROUPS.	AMERICAN FORMATIONS.
Cenozoic.	20. QUATERNARY.	20. Recent.
	19. TERTIARY.	19 c. Pliocene. 19 b. Miocene. 19 a. Eocene.
Mesozoic.	18. CRETACEOUS. 17. JURASSIC. 16. TRIASSIC.	18. Cretaceous. 17. New Red Sandstone. 16. New Red Sandstone.
Paleozoic.	18-15. CARBONIFEROUS.	15. Permo-Carboniferous. 14. Coal Measures. 13 b. Mississippi, (Carb. limestone.) 13 a. Waverley or Bonaventure.
	8-12. ERIAN OR DEVONIAN.	12. Catskill. 11. Chemung and Portage. 10. Hamilton, (Including Genesee and Marcellus.) 9. Corniferous or Upp. Helderb'g. 8. Oriskany.
	5-7. SILURIAN.	7. Lower Helderberg. 6. Onondaga or Salina. 5 c. Niagara, including Queiph. 5 b. Clinton. 5 a. Medina. 5 a. Oneida.
	3-4. ORDOVICIAN, (Upper Cambrian of Sedgwick or Siluro-Cambrian.)	4 c. Loraine. 4 b. Utica. 4 a. Trenton. 3 a. Chazy.
	2. CAMBRIAN. (Middle and Lower Cambrian of Sedgwick.) (Keweenawian.)	2 c. Calciferous. { Upper Taconic 2 b. Potsdam. { or Quebec Gr'p. 2 a. Menevian. (St. John's group.)
Eozoic.	1. PRIMARY OR CRYSTALLINE. (Primitive and Transition.)	1 f. Taconian. (Lower Taconic.) 1 e. Montalban. 1 d. Huronian. 1 c. Arvonian. 1 b. Norian. 1 a. Laurentian.

TABLE OF THE GEOLOGICAL FORMATIONS.

Systems or Ages.			GROUPS OR PERIODS.		FORMATIONS OR EPOCHS.	
19-20. CENOZOIC.	20. Age of Man.		20. QUARTERNARY.		20. Quarternary.	
	19. Age of Mammals.		19. TERTIARY.		19 c. Pliocene. 19 b. Miocene. 19 a. Eocene.	
16-18. MESOZOIC.	16-18. Reptilian Age.		18. CRETACEOUS.	Rogers' Pa. and Va. No's.	18 c. Upper Cretaceous. 18 b. Middle " 18 a. Lower "	
			17. JURASSIC.		17. Jurassic.	
			16. TRIASSIC.		16. Triassic.	
2-15. PALEOZOIC.			15. PERMIAN.		15 Permo-Carboniferous.	
			14. CARBONIFEROUS.	XV. XIII XII.	14 c. Upper Coal-measures. 14 b. Lower Coal-measures. 14 a. Millstone Grit.	
			13. SUBCARBONIFEROUS.	XI. X.	13 b. Upper Subcarbonif'ous. 13 a. Lower "	
			12. CATSKILL.	IX.	12 Catskill.	
			11. CHEMUNG.	VIII "	11 b. Chemung. 11 a. Portage.	
			10. HAMILTON.	"	10 c. Genesee. 10 b. Hamilton. 10 a. Marcellus.	
			9. CORNIFEROUS.	" "	9 c. Corniferous. 9 b. Schoharie. 9 a. Cauda Galli.	
			8. ORISKANY.	VII.	8 Oriskany.	
			5-7. SILURIAN.	VI. V. IV.	7 Lower Helderberg. 6 Salina. 5 c. Niagara. 5 b. Clinton. 5 a. Medina and Oneida.	
			3-4. SILURO-CAMBRIAN, or Trenton.	III. II. "	4 c. Cincinnati, Hudson River or Loraine. 4 b. Utica. 4 a. Trenton. 3 b. Chazy. 3 a. Calciferous.	
			2. CAMBRIAN, or Primordial.	I.	2 b. Potsdam. 2 a. Acadian. 2 a. Georgian.	
1. Eozoic or ARCHEAN.					1 b. Huronian. 1 a. Laurentian.	

DESCRIPTIONS OF THE GEOLOGICAL FORMATIONS.

INTENDED FOR RAILWAY TRAVELERS WHO ARE NOT VERSED IN
GEOLOGY.

All the rock-formations which appear on the surface of the globe, have been scientifically classified by geologists, according to the order in which they are found lying one upon another, and by the fossils they contain, and for our object may be conveniently included in twenty divisions or groups. In this work, the table of the names of the formations, groups and systems, published by Prof. J. D. Dana in his "Manual of Geology" and in his "Text Book of Geology," has been taken as the general basis, by the geologists of many of the states who have assisted in preparing the following guide, but other valuable tables and especially one arranged by Dr. T. Sterry Hunt, a general or combined table, and a list for each state at the beginning of the proper chapter, are also given. Numbers are attached to the names of the groups wherever they occur, making 20 in all. The subordinate members of each group, which are called formations, have the same number, but these sub-divisions are distinguished by the addition of small letters, a, b, c, etc., thus making in all 40 sub-divisions. By this means, the reader, although not familiar with geological tables, is at once enabled to see to what part of the general series any formation belongs, number 1 designating the oldest and number 20 the upper and last formed of all. Wherever the formations are found, they occur in the order as they are numbered, but the series in nature is never full, and in almost every locality one or more members of it are wanting.

The true method by which each of the great stratified formations is distinguished is by its own characteristic fossils, but these descriptions, having been prepared for travelers, are confined to the general aspect of the rocks as seen in passing them on the railways. They are intended to be popular rather than scientific, informing the reader what the formations are, what they look like, and their useful and valuable characters, qualities, and productions. It must also be borne in mind that this is a country of vast dimensions, and that the formations undergo important changes in their lithological character from place to place.

Paleontology, and other interesting branches constituting the purely technical portion of the subject, are omitted. That ground has been well covered by all of the excellent illustrated text-books on geology, and one object of this work is to induce persons to take up their study. Results only are here given, not the method, by which they are attained. The thicknesses of the formations are sometimes stated, but as this might mislead the unprofessional reader, it should be observed, that the width of the surface occupied by a formation depends on the amount of dip in the beds. A group less than a hundred feet thick, lying horizontally, may cover several miles, while one of several thousand feet thick, if lying at a high angle, is soon passed over.

1. EOZOIC (ARCHÆAN, AZOIC).

I. PRIMARY OR CRYSTALLINE ROCKS.

The late investigations of American geologists have enabled them to establish several divisions in the crystalline stratified rocks, which were originally called Primary or Primitive. The name Azoic, formerly given to the Primary rocks to distinguish them from the Paleozoic formations, has, since the discovery of Eozoon in the former, been exchanged for that of Eozoic. The designation Archæan or ancient rocks, is used by Professor Dana and others, and applies to the Primitive formations without distinction. Among those who have made the Primitive or crystalline rocks a special subject of study for many years, no one is more eminent than Dr. T. Sterry Hunt, whose classification of these rocks established by him in North America has since been recognized by many geologists in Europe, where the same great groups are found. The following descriptions, giving the latest conclusions as to the divisions of the Crystalline rocks, have been furnished by him for this second edition of this work.

1 a. Laurentian.—The name of Laurentian was given in 1854, by the geological survey of Canada, to the ancient crystalline terrane which forms the chief portion of the Laurentide hills, and of the Adirondacks.

Throughout these areas the prevailing rock is a strong, massive gneiss, reddish or grayish in color, sparingly micaceous, but very often hornblendic. The predominance of this mineral occasionally gives rise to a nearly pure hornblende-rock, sometimes with a little intermixed feldspar. The gneisses are, for the most part, distinctly stratified, but occasionally the evidences of stratification are not very apparent, so that these rocks have often been designated granites. This series is distinguished by the absence of chloritic, talcose, argillaceous or micaceous schists. It includes, however, crystalline limestones, of which there are supposed to exist, in the Ottawa valley, three distinct masses in the Laurentian series, each of which is, in parts, according to Logan, more than 1,000 feet in thickness. These limestones, which are generally coarsely crystalline, are often magnesian, and abound in foreign minerals, chief among which are serpentine, chondrodite, hornblende, pyroxene, magnesian mica, apatite and graphite. Most of these occur both disseminated in the beds, and, aggregated with other minerals, in veins, or endogenous masses. Associated with these limestones are often considerable beds of quartz-rock, sometimes garnetiferous. Great masses of magnetic oxide of iron are also found interstratified in this series. The measured thickness of the Laurentian gneisses, with their included limestones and other rocks, on the Ottawa, where the strata are nearly vertical in attitude, has been estimated at over 17,000 feet. Beneath these, known as the Grenville series, there is a great underlying mass of granitoid gneiss, without limestones, and of undetermined thickness, called the Ottawa gneiss, which, it is conjectured, may not be conformable with the upper portions.

In the Atlantic belt, considerable areas of Laurentian occur in Newfoundland, and probably in several parts of New England. A range of Laurentian rocks from the Western part of Connecticut extends southwestward, forming

the Highlands of the Hudson, and making the South Mountain as far as the Schuylkill; while a smaller range of the same, to the southeastward, forms the Welsh Mountain, in Pennsylvania. Little is known of the distribution of the Laurentian farther southward, but gneisses near Richmond in Virginia, and at Roan Mountain, in North Carolina, are referred to this terrane.

Large areas of Laurentian occur around Lake Superior, and farther west in the Rocky Mountains, where they form the crystalline rocks of the Colorado range in the east, and those of the Wasatch in the west, and probably occur in many other parts of the region. To the Laurentian belong the gneisses of the Western Islands of Scotland, those of Scandinavia and Finland, and large portions of those of the Alps. The limestones of the Laurentian contain the remains of a foraminiferal organism known as *Eozoon Canadense* (Dawson), which has been found in several localities in Canada, and also in Bavaria, and in Finland. Accompanying it are several other small forms, regarded as organic, and referred to the protozoa.

1 b. Norian.—The upper portion of the Laurentian series on the Ottawa river, was originally defined by the geological survey of Canada as consisting of a rock, gneissoid or granitoid in character, made up chiefly of labradorite, or related anorthic feldspars, but including also true gneisses and crystalline limestones, not unlike those already described in the Laurentian. Subsequent studies in Canada led to the conclusion that these rocks constitute a distinct terrane, resting unconformably upon the gneisses and crystalline limestones of the preceding series, and the two were respectively designated as Lower Laurentian and Upper Laurentian or Labradorian. As the newer is very distinct from the older terrane, it has, however, been thought better to restrict the name of Laurentian to the latter. A series precisely similar to the upper one occurs in Norway, where, as in North America, it rests upon Laurentian gneisses, and where the name of norite has been given to the feldspathic rock which is its chief characteristic. Hence, the name of Norian, which has been chosen in place of Upper Laurentian, as the designation of the terrane. It is conjectured, from the fact that it has yet been found only in contact with the Laurentian, and from its including gneisses and limestones lithologically similar to those of the latter, that it is next in age.

The norites consist, for the greater part, of anorthic or plagioclase feldspars, sometimes almost without admixture, but at other times accompanied by small portions of hornblende, of pyroxene or of hypersthene, constituting what has been called hypersthene or hyperite. Chrysolite, red garnet, green epidote, biotite, and ilmenite are often present, and these minerals are generally arranged in such a way as to give a gneissoid structure to the rock. The texture is sometimes fine-grained and compact, and at other times more coarsely granular, and even granitoid, displaying great masses of the plagioclase feldspar, frequently opalescent, and varying in composition from anorthite to andesine. The colors of the norites vary from white, pale bluish or greenish, rarely reddish, to dark lavender or smoke-blue, or nearly black.

The principal area of this terrane known in the United States is in Essex county, New York, where it covers several hundred square miles, and, although highly inclined, rests unconformably, according to Professor Hall, upon the

Laurentian. It is well displayed upon the shore of Lake Champlain, between Port Kent and Westport, and forms some of the highest hills of the interior. A second large area of Norian occurs north of Montreal, where it is similarly related to the Laurentian, and passes below the Potsdam sandstone. Other localities along the valley of the St. Lawrence are at Chateau Richer near Quebec, at Bay St. Paul, the Bay of Seven Islands, and on the River Moisie. Extensive areas of it also exist on the coast of Labrador. The same rock has been found on the east shore of Lake Huron, at the west end of Lake Superior, as at Duluth, and in Wyoming Territory.

1. c. Arvonian.—There is found in many localities a series of highly inclined stratified rocks, consisting essentially of petrosilex or hallefinta, often passing into a quartziferous porphyry. There are found with it strata of vitreous quartzite and thin layers of soft micaceous schists, besides great beds of hematite, and, more rarely, layers of crystalline limestone. This group, which has a thickness of many thousand feet, was at first included in the succeeding Huronian series, which, however, apparently overlies it unconformably.

Its relations with the preceding groups have not been clearly determined, but it appears to be identical, both in position and in character, with the group, which in Wales has, since 1878, been called Arvonian. These Arvonian rocks are well seen at many points along the coast of Massachusetts and New Brunswick and in the Atlantic belt in southern Pennsylvania. Areas of them are also seen on the north shore of Lake Superior, and rising through the paleozoic sandstones in Wisconsin. They appear under similar conditions in southeast Missouri, where they include great beds of iron-oxyd.

1 d. Huronian.—The name of Huronian was given in 1855 by the geological survey of Canada, to a series of more or less schistose crystalline rocks, shown to rest upon the Laurentian series on the north shore of Lakes Huron and Superior. A similar series is largely developed in the Atlantic belt in Newfoundland, in the province of Quebec, and in New England, and farther southward in the Blue Ridge. The Huronian differs from the preceding series by the frequent presence of schistose rocks, and of conglomerates, which contain fragments of the underlying gneisses. The Huronian contains a considerable portion of epidote, hornblende and pyroxene, and is marked by varieties of diabasic rocks, often called gabbros, which are truly stratified, but are not to be confounded with the norites of the Norian series, to which the name of gabbro is also often given. The Huronian series moreover includes imperfect gneisses, quartzites, dolomites, serpentines, and steatite, besides large amounts of chloritic, micaceous and argillaceous schists. Its thickness has been estimated at about 18,000 feet, and it is often found resting unconformably upon the gneiss of the Laurentian. Ores of copper, nickel, chrome and iron are common in the Huronian series, which is penetrated in many localities by unstratified rocks, both granite and doleritic.

The rocks in the British Islands, which have lately been described by the name of Pebidian, are apparently identical with the Huronian; and the great series in the Alps, known to the Italians as the *pietri verdi*, or greenstone group, or at least its lower portion, has both the lithological characters and the geognostical relations of the Huronian, to which it is now generally referred. Similar crystalline schists found in California, both in the foot-hills

of the Sierras and in the Coast Range, are probably Huronian. The gold veins of California traverse both these schists and the penetrating granites.

1 e. Montalban.—The name of Montalban was given in 1872 to a great series of crystalline schists which are lithologically and geognostically distinguished from the Huronian, and are well displayed in New Hampshire in the White Mountains (whence the name). It occupies large areas in New England and constitutes the gneisses and mica schists of Philadelphia, Baltimore and Washington, extending southwestward into Alabama, and, in the absence of the intermediate groups, often rests directly on the Laurentian gneiss. This is well seen on the Island of New York, on the north part of which the older gneiss, which makes up the Highlands of the Hudson, appears from beneath the Montalban, which covers the greater part of the island. The Montalban series contains fine grained white gneisses, sometimes porphyritic, but distinct from the granitoid gneisses of the Laurentian, and passing into granulites on the one hand, and very quartzose, coarse grained mica schists, chiefly muscovitic, on the other. It also includes hornblende in some parts, and the gneiss, by a predominance of this mineral, passes into a nearly black schistose hornblende-rock. Beds of granular chrysolite rock (accompanied by enstatite, and by serpentine, often with chromite, are found interstratified in this series in North Carolina and in Georgia. It also includes beds of crystalline limestone, which resemble those of the Laurentian, and moreover includes large deposits of iron pyrites and copper pyrites. The fine grained gneisses of the Montalban are sometimes called granites, but the series is penetrated by great masses of true intrusive granite. The mica schists of the series often contain garnet, staurolite, cyanite and andalusite; these species, with the exception of the first, not being, so far as known, found in the Laurentian series. The endogenous granitic veins carrying muscovite, iolite, spodumene, beryl, columbite, tinstone and apatite in the Atlantic belt, occur chiefly in the Montalban series. The Montalban is supposed to be represented by the younger gneissic and mica schist series of Scotland, which has been called Upper Peibidian, Grampian and Caledonian. It corresponds to the younger gneissic series of the Alps, where it is generally, though not everywhere, separated from the older Laurentian group by a great development of Huronian.

1 f. Taconian.—Along the great Appalachian Valley from Vermont to Alabama extends a belt of quartzite, limestone and crystalline schists with roofing-slates, which, by many geologists, have been regarded as a great development in an altered condition of the Cambrian and Ordovician (Potsdam-Lorraine). These rocks, called by H. D. Rogers Primal, Auroral and Matinal, are regarded by others as older than the Potsdam, and constitute the Lower Taconic of Emmons, since called Taconian. They include the Itacolumitic series of South Carolina, and have a general thickness of 4,000 to 5,000 feet. In these are found the white marbles of the Valley, the great deposits of limonite and beds of magnetic and specular iron ores. To this series are also referred the similar series of rocks in northern Michigan and Minnesota, including what has been named the Animikie series, which have been confounded with the Huronian. A great series of similar rocks is found in the Alps between the younger gneisses and the paleozoic. T. STERRY HUNT.

2-15. PALEOZOIC.

2-4. CAMBRIAN (OR LOWER SILURIAN) AGE.

2 a. Acadian.—This series is found at Braintree, in Massachusetts, at St. John, in New Brunswick, and at St. John, in Newfoundland. It includes one thousand feet or more of fossiliferous sandstone and shale, and according to Dr. Hunt, corresponds to the Menevian of Great Britain. It has only been found along the north-eastern border of the Atlantic belt. It is remarkable as a fossiliferous rock below the Potsdam, which had, before its discovery, always been considered as the lowest formation of that description on the continent.

2 b. Potsdam.—The Potsdam sandstone, was for a long time considered as the lowest sedimentary fossiliferous rock. It is usually of a purely quartzose character, generally gray, though often striped, and sometimes partially or entirely red. In places it appears as a conglomerate, but sometimes the enclosed masses are angular, showing them to be near their source.—Hall, N. Y. R., 27. It is a hard silicious sandstone, white, red, gray, yellowish, and frequently striped. Some strata of this rock are covered with the most beautifully characterized ripple-marks as perfect as if just formed on the sand of a sea-beach, while the rock is the most indurated kind of sandstone. Its lower portion is a granitic conglomerate, in which large masses of quartz, the size of a peck measure, are often enveloped; they are rounded and water-worn, and held together by a finer variety of the same material. On the Canada slope, where the mass is 300 feet thick, it is wholly a conglomerate, made up of coarse materials. The part which is properly a sandstone, has two principal varieties, a close grained, sharp edged mass, with natural joints traversing it in two directions, but so closely wedged together that it is quarried with difficulty. This is the Keeseville variety, and that of Pa. and N. J. The other, the typical mass at Potsdam, is an even bedded and somewhat porous rock, at many places a distinct friable sandstone, in others a yellowish-brown sandstone, the particles of which are compacted together, so as to form a firm, even-grained mass, with the planes of deposition perfectly smooth and separable from each other, the layers being from two inches to four feet thick. At Potsdam quarries, a layer of 100 square feet may be raised and split into rails, six inches wide and ten feet long, or it may be broken into pieces the size of a brick, with even edges of fracture, and each layer may be separated into many. The color here is yellowish-brown, and a deep red variety occurs at Chazy, resting immediately upon the primitive rock.—Mather, 102. It is nowhere charged with mineral matter, either disseminated or in veins. The native copper of Lake Superior is in an old trappean formation, and has no relation to the neighboring extensive formation of Potsdam. In an economical point of view, the Potsdam is unimportant as a depository of useful substances.

The general color of the stone at Potsdam is yellowish-brown, but the tint of each layer differs somewhat from those adjacent to it, so that the rock, upon the fractured edges, wears a slightly striped aspect. It is the finest quarry stone in the state, being so perfectly workable and manageable.—360. It is an excellent building material, holding mortar well, and makes a dry house.—29. Under the Potsdam, and upon the primary rock, is the position of the specular and red oxide of iron.—V. 267.

In Minnesota, the lower portion of the formation is 400 feet thick, and is hard and often vitreous, and usually of a brick-red color, with very distinct layers, often separated into slaty layers by partings of red shale, strongly marked with fucoidal impressions, frequently ripple-marked and cracked. The upper part of the formation, there called the St. Croix sandstone, is white or buff in color, often friable, and constitutes a heavy bedded or massive sandstone of rounded quartzose grains.—N. H. Winchell.

In Minnesota and Iowa, the Potsdam proper, omitting the St. Croix sandstone, is a friable, crumbling mass, of no value for building purposes except as sand, consisting of a pure silicious sand in minute grains, with a very slight amount of cementing matter. Unless protected by some more resisting rock above it the Potsdam appears in steep slopes, or low, gently swelling hills and mound-like eminences. Those portions which are hard and enduring are cemented by oxide of iron, and have a brown color.

In Wisconsin, the Potsdam is 800 to 1000 feet thick, and has a much larger surface-development than elsewhere, as will be seen by the great number of railway-stations on it. It extends over 12,000 square miles, and contains many fossils not found in New York. Where the Potsdam in Wisconsin is on the surface, and not covered by drift, there is usually a loose, sandy soil, with a sparse growth of small oak and pine timber. This formation is one that has been very properly allowed to retain its original name almost undisputed all over the United States, except that Professor Owen at first called it the *Lower Sandstone*, in the North West to distinguish it from the *St. Peters* or *Upper Sandstone*.

In Michigan, the Potsdam is the red sandstone, which is emphatically the chief rock that appears upon the immediate coast of the whole south shore of Lake Superior, and forms the Pictured Rocks and the Falls of St. Marie. Here it is of inconsiderable thickness, but it regularly thickens in going westward.—Houghton, 4th R., 500. Some have referred the Lake Superior sandstone to the age of the Chazy, but the late studies of Rominger show that it is really of Potsdam age. The Chicago Tribune office building is of this Lake Superior sandstone, and the Court House at Milwaukee is another conspicuous specimen.

In Pennsylvania, the Potsdam is a compact, fine-grained, white and yellowish vitreous sandstone, containing specks of Kaolin.

The Potsdam formation is supposed by some to be represented in the Green Pond Mountain of New Jersey by a local deposit of coarse conglomerate, 3000 feet thick, but others deny that this mountain is Potsdam. It is less than 30 feet thick where it is seen rising from beneath the limestones of the Lehigh River, but increases in thickness westward and southward, until it comes to be represented in Tennessee by many thousand feet of alternate coarse and fine deposits. See Safford's *Geol. R. of Tenn.*

3 a. Calciferous.—This group embraces in New York three distinct masses as to character and position, and these alternate and intermix with each other. The first is silicious, compact, and may probably be the continuation of the Potsdam sandstone. The second is a variable mixture of fine, yellow, silicious sand and dolomite or magnesian carbonate of lime, which, when fractured, presents a fine, sparkling grain. It is in irregular layers, which have a shattered appearance, from numerous cracks, the parts being more or less separated from each other. This is the mass from which the name Calciferous sandrock was derived. The third is a mixture of the dolomite material, which is usually yellowish, very granular when fresh broken, and of a compact limestone, which resembles the Birdseye. The action of the weather gives these layers the appearance of Gothic fret-work, and the color becomes a dark yellow-brown.—V. 21. As its name indicates, it is a sandy magnesian limestone, but it is not destitute of beds of pure limestone. The mixture of a variety of mineral matter causes the rock to weather unequally; hence it is often rough externally, portions of the silicious part standing out in relief. There are two quite uniform characters which distinguish the Calciferous, viz: A fine crystalline structure intermixed with earthy matter and numerous small masses of calcareous spar.—E. 105. Great numbers of quartz crystals are found in the cavities of this formation, many of them very perfect as to form and transparency.—V. 30.

In the Mississippi basin this formation is called the LOWER MAGNESIAN LIMESTONE, to distinguish it from the Upper or Trenton limestone. The eastern name, Calciferous or lime-bearing sandrock, does not apply, as it is almost free from sand. As its western name indicates, it is a dolomite or magnesian limestone, and makes an excellent lime for building purposes. It usually contains about one equivalent or forty-five per cent of carbonate of magnesia. This limestone forms the summits of the bluffs of the Mississippi; it supports high table-lands that extend back from the river, and forms prominent angles to the summits of the bluffs on either side of that river. These even and heavy layers are those usually quarried for building-stone. D. D. Owen gives descriptions of the picturesque character of the landscape in the region of the Upper Mississippi, and especially the striking similarity which the rock exposures present to ruined structures, and his report is illustrated by beautiful engravings showing the castellated appearance of the cliffs of the Lower Magnesian limestone on the Iowa river. In Pennsylvania it is a coarse, gray, calcareous sandstone, containing cavities enclosing very minute crystals of quartz and calcareous spar.

3 b. Chazy.—To the Calciferous succeeds the Chazy limestone. As a whole, it is a dark, irregular, thick-bedded limestone. At Chazy, New York, on Lake Champlain, it contains many rough, irregular, flinty or cherty masses. At Essex the beds are more regular, and form, in consequence, a better building stone. As a limestone it is purer than the Calciferous, being non-magnesian; the principal foreign matter is silica in the form of chert. It is free from the brown earthy spots, and the masses of brown calcareous spar so common in the Calciferous sandrock.

This formation is 130 feet thick on Lake Champlain, but it is less constant in the series than the others, and as it is not an important formation on the

lines of the railroads, an extended description is not here necessary. It is not found in the valley of the Mohawk. Its fossils are found in Pennsylvania and Virginia, but its limits are not there defined. In the Northwestern States the St. Peter sandstone occupies the same place in the series as the Chazy in the east.

3 b. St. Peter Sandstone (Upper Sandstone of Owen).—This is a western formation and does not occur in the Eastern States, but Prof. Lesley thinks it may have representatives in the massive silicious members of the great limestone mass of from 5,000 to 6,000 feet thick, as measured along the two branches of the Juniata in Pennsylvania. It is first recognized in going west, to the southwest of Winnebago Lake. It is also seen up the Mississippi, near St. Paul and St. Anthony, and on the streams of northeast Iowa, and at La Salle, Illinois, where it is brought to the surface by an anticlinal axis. It is remarkable for its uniform thickness, which is from 72 to 100 feet over a space of 500 miles in length and 400 miles in width. In Central Wisconsin, however, its thickness is very irregular. It is also of the same character throughout, being composed of wonderfully uniform and exceedingly minute grains of sand, held together by the merest trace of cement, so that the mass may easily be moved with shovel and pick, as is everywhere done for the purpose of obtaining sand for mortar. This sandstone, though usually white, sometimes assumes a buff or brown color from the presence of iron, and in some localities it becomes red or is marked by bands of a bright green color. It appears like a recurrence of the Lower or Potsdam sandstone. Being composed almost entirely of pure silica, it is, when not colored by oxide of iron, one of the very best materials yet discovered in the west for the manufacture of glass. It is the same as that known in Missouri as saccharoidal sandstone, which is carried to Pittsburgh, Pennsylvania, and used by the glass-makers in manufacturing the best kinds of glass. See note 2, Missouri.

4 a. Trenton Limestone.—Next in ascending order occurs the 4 a. *Trenton* limestone, which, in the Northwestern States, is divided into the Buff limestone and Blue limestone. In Wisconsin there are two buff and two blue beds alternating. They are undoubtedly the same as the well known Chazy, Birdseye, Black River and Trenton limestones of New York and other Eastern States. They are known in the West wherever the exposures reach to the upper sandstone.

The upper member of the 4 a. Trenton limestone, in South Western Wisconsin and the adjoining parts of Illinois and Iowa, is the very important GALENA or lead-producing limestone, which has no exact representation in the Eastern States. It is a light gray or a yellowish-gray, heavy-bedded rock. It is compact, minutely crystalline throughout, often with small cavities lined with crystals of brown spar, and the whole thickness of the formation is 250 feet. The Galena or lead ore contains 13.4 per cent. of sulphur and 86.6 per cent. of lead, and is found in heavy bodies in crevices in this Galena dolomite or magnesian limestone. Prof. J. D. Whitney, in his admirable report on the geology of the lead region of Southwestern Wisconsin, has proved that these lead deposits must have been introduced into the fissures by precipitation from above. The lead mines of Missouri are chiefly in the Lower Magnesian limestone.

In Wisconsin, a very noticeable feature of the Trenton limestone is its marked division into the two parts before mentioned. One, which is the lower half, is very heavy bedded, in layers of two or three feet thick, known as the glass-rock, and the other thin bedded, in layers of two or three inches. There is always a stratum of carbonaceous shale from a quarter of an inch to a foot or more in thickness, which separates the blue or Trenton from the thin bedded Galena limestone above it.

Professor R. D. Irving describes the Galena limestone as almost invariably a very compact, hard, crystalline rock, of a yellowish-gray color, with numerous small cavities filled with a softer material, or lined with crystals of calcite. The upper portion is thick bedded and free from flints, the layers being from one to four feet thick, while the lower portion almost invariably consists of several feet of layers from one to two inches thick. Good exposures of parts of the Galena limestone are frequently to be met with. It may be seen in cliffs and ledges, on nearly all the streams in the lead region, where it weathers irregularly, leaving the surface full of small cavities, due to the removal of its softer parts. The formation contains masses of flint in layers, or in irregular pieces, which are principally confined to the middle and lower parts of the formation, although not entirely absent from any part.

In the interior valleys of Pennsylvania, as for example, in Sinking Valley, Blair Co., considerable quantities of zinc ore, and some galena, have been found in the Trenton limestone group, which is there at least 1,000 feet thick. The lead mines of Wythe Co., Virginia, are at the same, or at a somewhat lower horizon. The zinc mines near Bethlehem, Pennsylvania, and near Landisville, Lancaster Co., are nearly of the same geological age. Isolated crystals or small masses of galena occur in crevices in the limestone beds of this age throughout the entire range of the great valley from Newburgh, on the Hudson, to Chattanooga, in Tennessee. The limestones in this valley, which are the Auroral limestones of H. D. Rogers, are, by some geologists, referred to an older series.

In the State of New York the lower part of the Trenton is called the Birdseye. It is a perfectly pure limestone, and the next layer, which is the middle or Black River sub-division, is sometimes used as a marble. It is solid, hard, and easily worked, by reason of its conchoidal fracture, and is valuable for lime and for building.

The upper part of the formation, or Trenton limestone proper in New York, consists of two distinct varieties, at Trenton Falls. The first or upper part is a dark or black colored, fine grained limestone, in thin layers, separated regularly by black shale or slate, forming the great mass in which the creek has worn its channel, and in which are all the falls. See Note 62, New York.

The second, or lower part of the Trenton proper, is a gray, coarse grained limestone, in thick layers, and it is quite crystalline. This is the quarry-stone at Prospect, above Trenton Falls. At Montreal, the church of Notre Dame and many other structures are constructed of the gray variety of the Trenton limestone, quarried behind the city, but the thinner layers, when not dressed, are of a more pleasing color, and make a handsomer building-stone.

The Trenton formation in all parts of the United States, is almost always a limestone. A conspicuous example of the Trenton, Utica and Hudson River formations, is seen in the long continuous and beautiful valley of the Hudson and Lake Champlain, the Kittatinny valley of New Jersey, the Cumberland valley of Pennsylvania, the Shenandoah valley of Virginia, and the valley of East Tennessee. The fertility of its limestone land is almost inexhaustible. The deposits of brown hematite iron ore, found in the soil, and occupying hollows or basins in the softer limestones below the Trenton in so many places, and in such large quantities, are supposed by some to be of aqueous origin, and not strictly a product of this formation, which is only its receptacle. But many other geologists,—R. M. S. Jackson, A. A. Henderson, Lesley, Platt, Prime and Frazer, have all agreed in advocating the opposite view, each from his own independent studies. They derive the limonite beds either from the solution of the ferriferous limestone layers, or from the intercalated micaceous slates, or from the pyrites-bearing slates of the neighborhood. According to Dr. Hunt, it comes from the change of masses both of iron-pyrites and of carbonate of iron, originally imbedded in the limestones and slates.

4 b. Utica Slate.—The Trenton limestone is succeeded by a dark or black carbonaceous slate, called the Utica slate. In Pennsylvania this formation is everywhere darkly colored, and the coloring matter is probably derived from abundant remains of marine plants or animals. While the black color of some of the clays in the brown hematite ore banks of the upper range (immediately beneath the Utica slate), as at the mines in Lehigh Co., Pa., and the Brandon ore mine in Vermont, seems to be derived from the black slates of the Utica, the gray color of some of the limestones, and of the carbonate ores (as at the Saucon zinc mines) is known to be due to disseminated graphite.

Within the State of New York, it is everywhere black, and usually soft and fissile. Thin beds of impure limestone are associated with it in many places, and sometimes thin layers of carbonate of iron, and it passes into the Trenton limestone by gradual interstratification. Thus bands of slate are interstratified in the limestone, and thin strata of limestone containing fossil remains in the lower part of the slate. These crumbling shales may generally be distinguished by their dark blue-black and brownish-black color, but there are some strata among the grits of the Hudson River that can scarcely be distinguished from these. The Utica slate weathers ash-gray, rapidly disintegrates, and, where it is exposed in cliffs, frost and other agents constantly break it into small fragments, which collect at the base in the form of a talus. In Pennsylvania, it outcrops, with little or no variation, as a dark blue carbonaceous slate and shale, extremely fissile in its lower beds. It forms the surface-rock along a narrow region in the Mohawk valley. In East Tennessee, the beds both of Utica and Hudson River, or Cincinnati, are of great extent, and consist of blue calcareous and sandy shales, with some layers of calcareous sandstone. Professor Hall considers the Utica slate as properly the lower member of the Hudson River group.

4. c. Hudson River (Cincinnati, Nashville, Loraine and Frankfort sandstone and shale).—The rocks of this group in New York are mostly slates,

shales and gray, slaty and thick-bedded grits. The slates and shales are generally dark brown, blue and black, and the grits are gray, greenish and bluish-gray. They are stratified and conformable, alternating a great number of times, without any regular order of alternation, and in Eastern New York are from 500 to 800 feet thick. The first New York geologists called this formation the Greywacke, and it is still so called by the stone-cutters on the River Hudson. Its lower portion was called the *Frankfort* slate and sandstone, and the upper part the *Pulaski* shale and sandstone, which latter were afterwards called the *Loraine* shale. Wherever streams have passed over it they have, in process of time, worn in the rocks a deep channel or gorge sometimes preventing a free communication across them, as at Loraine (see Note No. 69, New York). By decomposition, it produces a tenacious, clayey soil, favorable for grass, forming the best dairy-land, as in Orange Co., New York, about Goshen and Middletown. It increases in thickness southward so rapidly that at the Delaware and Lehigh water gaps, measurements of 5,000 feet have been made through it, from its top downward, without reaching its lower limit.

In many places along its last outcrop toward the Atlantic, it has furnished many masses of a substance resembling anthracite, also beds of impure limestone, and beds of red shale, which increase very much going south into Virginia.

In Pennsylvania, the Hudson River slate consists of blue and greenish-gray shale, alternating with gray calcareous and argillaceous sandstone in thin beds. The sandstones grow more abundant as we ascend in the formation. The middle portion, where much metamorphosed and intersected by cleavage-planes, in certain localities, produces a good roofing-slate, as at Slatington and Delaware Water Gap, Pa.

The geologists of the Western States generally, have dropped the designation of Hudson River, at least in regard to strata west of the Alleghanies, and have substituted for it the name, CINCINNATI, proposed by Worthen and Meek; making this term co-extensive with the former. In this guide, Hudson River is used in the Eastern, and Cincinnati in the Western States. At Cincinnati the whole series is about 800 feet thick, and, according to Dr. Newberry, by its fossils, is the equivalent of the Chazy, Trenton, Utica and Hudson River, all blended together. In Ohio it is composed of alternating beds of limestone and shale, the latter sometimes called blue clay. The limestone is an even-bedded, firm, durable, semi-crystalline limestone, crowded with fossils. It is commonly called the *blue limestone*, but the prevailing color is grayish-blue, and the weathered surface shows yellowish or light-gray shades. In southern Illinois the lower part of the Cincinnati is composed of brown sandy shales and sandstone, and the upper portion is a thin-bedded, dark bluish-gray, fine grained limestone, two to six inches thick, with shaly partings between the layers. In northern Illinois it is bituminous, and consists of sandy shales with thin bands of limestone. In Iowa it is the Maquoketa shales, which are bluish and brownish shales forming a stiff clay soil. In Missouri the upper shale bed only is found, with an occasional flag-like limestone layer.

It should here be said that in the opinion of the earlier American geologists, Amos Eaton and Ebenezer Emmons, and as now maintained by Dr. Sterry Hunt, considerable portions of the strata above described, including what is called Potsdam sandstone in Pennsylvania, along the Appalachian Valley from New England to Alabama, as well as the great mass of accompanying limestones—the Auroral of Rogers—belongs to the Lower Taconic or Taconian series, and is of pre-Cambrian age. The name of Hudson River group, has hitherto been used in a very vague sense, and made to include not only the upper schistose beds, including the roofing-slate of the Taconian, and the much more recent Loraine or Cincinnati shales, but also a great intermediate series, called by Eaton the First or Transition Greywacke—the Utica, Loraine, and Oneida being his Secondary Greywacke.

This First Greywacke series, along the eastern border of the Appalachian valley in New York and New England, and thence southwest on the one hand, and northeast to the lower St. Lawrence on the other, is a great belt of disturbed strata, which were for a long time assigned by some geologists to a position above the Trenton limestone, while by others they were regarded as below that horizon, and of the age of the Potsdam and Calciferous divisions. Emmons, who for many years maintained the latter view, called these rocks the Taconic slates or Upper Taconic, a name which Logan, when he finally accepted this conclusion, changed to that of the Quebec group, divided into three parts, named by him Sillery, Lauzon, and Levis; the latter being supposed by him the oldest. It has since been shown that the Sillery is the oldest and the Levis the newest, its fauna approaching that of the Chazy; while some portions of this group (afterwards distinguished by Logan as Potsdam) contain a fauna as old, or older, than the typical Potsdam. These rocks, which have an aggregate thickness of 7,000 feet or more, are much disturbed, and include portions of strata of later date, Ordovician and Silurian. To this essentially Cambrian series, as already said, belongs a great part of what has been called Hudson River group, though this name, in paleontology, has been restricted to the Loraine shales, which belong to a higher Ordovician horizon.—T. S. H.

Keweenawian.—This name has been given to the great copper-bearing series of the Lake Superior basin, which, while resting in the different parts upon various crystalline groups, is unconformably overlaid by the Cambrian sandstones of the Potsdam. It is made up chiefly of sandstones and conglomerates, with interposed layers of basic eruptive rocks of cotemporaneous origin, generally designated melaphyres. This series abounds in metallic copper, found both in veins, and in the beds, but most abundantly in certain conglomerates. The thickness of the Keweenawian is not less than 20,000 feet, and perhaps much greater. Notwithstanding its great antiquity the Keweenawian does not belong to the crystalline rocks.

(T. STERRY HUNT.)

5-8. SILURIAN (OR UPPER SILURIAN) AGE.

5 a. Medina.—The lower member of this formation is a pebbly sandstone or grit called the Oneida conglomerate, being the same as the Shawangunk conglomerate. The upper member is called distinctively the Medina sandstone, and is usually a red or mottled argillaceous sandstone.

1. The Oneida conglomerate in New York is composed of quartz pebbles rarely exceeding three-fourths of an inch in diameter, and of white or yellowish quartz-sand. In some localities there is some interposed greenish shale. The source of its materials was to the south, the rock being 500 feet thick in the Shawangunk Mountain at Wurtsburg, on the N.Y. & Os. Mid. R. R., and 1000 feet thick in some parts of Pennsylvania and Tennessee. The greatest thickness of the Oneida in the eastern part of New York is 80 to 40 feet, but in the western part the same place is occupied by a gray quartzose sandstone, fine grained and compact. Passing upwards, the gray sandstone intermingles with the Medina sandstone, which, in its lower parts, differs chiefly in color. The red color of the Medina sandstone seems to be partially communicated to the gray below, which is often striped and spotted with red. There is, lithologically, no very strong line of demarcation between the two rocks. The oxide of iron, the red coloring matter of the upper member, has been transfused through the material of the lower as far as its particles could find admittance. The flagstones in the side-walks of Buffalo and Rochester, of a white color clouded with red, are of this formation.

In New Jersey the gray sandstone formation consists of a thick series of hard, white and whitish gray siliceous rocks, of various degrees of coarseness, from that of a fine grained, pure sandstone to that of a quartzose conglomerate with thickly-set pebbles averaging half an inch in diameter. This is the summit of the long, straight mountain ridge called the Kittatinny or North Mountain, extending from near the Hudson River into Virginia.

In Pennsylvania the Oneida conglomerate is a compact, greenish-gray, massive sandstone, containing in many places thick beds of siliceous conglomerate, and the Medina sandstone proper is a thick mass of alternating red shales and red and gray earthy sandstones. It is the North Mountain of the great Cumberland valley.

At the Delaware Water-Gap the whole mass of Oneida and Medina consists of seven massive plates of coarse sand and conglomerate, separated by more argillaceous layers from each other. Going west, the number, according to Prof. Lesley, is reduced to five, and finally in Middle Pennsylvania to two, each of them very thick, and making its own mountain-crest when the dip is vertical, while the intermediate softer red mass forms a little valley between the crests. The whole formation is about 1,900 feet thick. When the dip is gentle, the Oneida makes a beautiful lofty terrace upon the flank of the mountain, the crest of which is always made by the Upper Medina. Traced southward through Virginia into Tennessee, this formation gradually thins away to 50 feet, as seen west of Knoxville.

2. The Medina sandstone proper succeeds the gray sandstone, there being no definite line of division between them. In this rock is found the *Fucoides Harlani* affording a positive character whereby to recognize it in the series. This sandstone is almost invariably of a red color, generally a brown-red, more rarely variegated light red and yellowish, and in a few rare instances of a light or whitish color,

partially greenish. It is both fine grained and coarse grained, the latter usually of the deepest color, the former more variegated. The lower falls of the Genesee, below Rochester, 110 feet in height, are formed by this rock. The deep gorge and high cliffs on both sides of the Niagara River, at Lewiston, New York, are more than one-half excavated in the Medina.

In New Jersey it is a thick formation of red and variegated sandstones and shales. Its lower beds are a dark red sandstone of a very ferruginous composition, and extreme hardness, and in the middle and upper divisions of a brownish red shale and a very argillaceous sandstone, partly calcareous.

Neither the Oneida nor Medina are found west of Ohio. Some large masses of galena and copper-pyrites with blende, have been found in the Oneida or Shawangunk grit, on the Erie R. R. east of Port Jervis and at Ellenville, but they were soon exhausted. When the Medina is a heavy coarse rock it produces a poor, barren country, but in Western New York it is more calcareous, and the soil is much better.

5 b. Clinton.—This group consists of many different kinds of rocks or masses, from which circumstance it was first called the Protean group. The name of Clinton was given to it on account of the characteristic masses being found around the village of Clinton, in Oneida County, New York. It consists of green and black-blue shale, greenish, gray and red, soft marly layers, often laminated calcareous sandstone, encrinal sandstone, and red fossiliferous iron-ore beds. The most persistent member of the group is the shale. It is bluish when fresh quarried, but when long exposed it is always of a greenish hue. The next member is the greenish sandstone, which is in thin layers, having its surface generally covered with *fucoïdes*. This also has a bluish tint when fresh quarried. The third persistent member consists of two iron-ore beds in New York and several in Pennsylvania.

The term Protean is still applicable to the Clinton group, which, in some places, consists of thin shaly sandstones, shales, and even conglomerates; in others, of thin bedded, impure limestones, shaly sandstones, iron-ores, etc.: still again it appears as a duplicate series of shales, limestones and iron-ores, with some intermixture of sandy matter, all containing an abundance of marine shells. In the west the formation is limestone, and is of a more uniform character.

The Clinton formation produces the celebrated fossiliferous iron-ore generally known as the Fossil ore, which occurs in it in every state from New York to Alabama. In all its localities this ore is red or brownish-red, very hard, and where unaltered, invariably oolitic or in larger sized concretions. In New York, where it is extensively mined, there are two beds of it, generally about 20 feet apart, and upon an average about a foot and more in thickness. The oolitic particles are usually more abundant in the lower, the larger sized concretions in the upper bed. The two beds never appear at the same locality, or in the same line of section, but where the lower one occurs the upper one is wanting, and where the upper one occurs the lower one is not found.

In Pennsylvania the Clinton is a very extensive formation, nearly 2,000 feet thick, of slate, shales, sandstones and iron-ore, with the same variety as elsewhere, and its iron ore is very rich, productive and valuable. The outcrop of the ore-beds have been traced for hundreds of miles. In Dodge County, Wisconsin, near Milwaukee, the Clinton iron-ore, at Iron Ridge, is from 15 to 18 feet thick, but this is very unusual, and it is not in the same part of the formation as the fossil ore in the east. The deposits of this ore in East Tennessee and in Alabama, called the Dye-stone ore, are still more extensive.

5 c. Niagara.—This group consists of two distinct members, a shale below and a limestone above.

The shale in New York constitutes a very uniform deposit, while the limestone, from a thin concretionary mass in the east, becomes an extensive and conspicuous rock, constantly increasing in thickness, in a western direction, even far beyond the limits of that state. The cataract of Niagara is produced by the passage of the river over this limestone and shale, and, from being a well known and extremely interesting point, as well as exhibiting the greatest natural development of these rocks in New York, this name was adopted for its designation. In this vicinity, the limestone is 164 feet thick, with the shale beneath 80 feet thick. The lower part of the Niagara group exhibits a great development of dark bluish shale, which, on exposure, gradually changes to gray or ashen color, and forms a bluish or grayish marly clay. In this state it is undistinguishable from the ordinary clays, and its outcropping edges, when long weathered, are often considered as clay beds. The Niagara is a very extensive formation, but its shales are much more persistent and wide spread than its limestone member, in the east, but the limestone is more widely spread in the west. The gorge below the upper falls at Rochester is the best place to study these shales. In an agricultural point of view, this formation, like all limestones, is an admirable one. There is no better soil than that of the Niagara about Rochester, New York.

A silico-argillaceous limestone, in New York, forms the beds of passage from the soft shale below to the purer limestone above. It is of a dark or bluish color when freshly exposed, but soon changes to light gray or ashen. These beds of passage are succeeded by a dark bluish gray sub-crystalline limestone, of a rough fracture, and separated into thin courses by dark shaly matter. The third member is a coarse grained concretionary mass, in irregular layers, exhibiting a very peculiar contorted appearance, as if much disturbed while in a semi-fluid or yielding condition. The concretions often present cavities lined with crystals, or contain the remains of some organic body. This is the surface-rock in West Avenue in Rochester.

The Niagara limestone is the great limestone which, in Wisconsin, occupies the peninsula between Green Bay and Lake Michigan, and then stretches southward to the south limits of the state, and far into Illinois and Indiana. It will be noticed in looking over the Guide, how many railroad-stations in the western states, just mentioned are on the 5 c. Niagara, and how very extensive the formation must be. Its general appearance is that of a regularly bedded brown or buff dolomite, with occasional intercalations of beds of massive gray limestone. The quarries of beautiful buff limestone at Athens and Joliet, Illinois, so much used in Chicago for building-purposes, are in this formation. At Joliet there is 40 feet in thickness of this buff and gray limestone. West and northwest of Chicago the Niagara limestone is highly charged with petroleum, which oozes from the stone, blackening the face of walls built of it. On Goat Island, at Niagara Falls, the petroleum is also seen on the limestone in small quantities. In Michigan it is a grey crystalline, rather fine grained, moderately fossiliferous, dolomitic mass, 218 feet thick on Green Bay.

In Western Canada the upper part of the Niagara limestone contains peculiar fossils, and is called the Guelph, and in Wisconsin it is subdivided into the 4. Guelph, 3. Racine, 2. Waukesha and 1. Mayville beds.

This formation establishes the topographical distinction between the lower plain of Canada, in which lie Lake Ontario and Georgian Bay, and the upper plain of the United States, on which lie Lakes Erie, Huron and Michigan. Its terrace crosses Ontario, growing loftier as the thickness of the formation increases northwestward, until it becomes a range of limestone mountain-land, forming the peninsula between Lake Huron and Georgian Bay. It is there broken down in a range of islands, and reappears as a peninsula, just mentioned, cutting off Green Bay from the western shore of Lake Michigan.

The Niagara and other limestones above it, seem not to have been deposited in Pennsylvania between the Delaware and Susquehanna rivers, and in Middle Pennsylvania. While the limestones below it are well represented, the Niagara is wanting as a separate formation, and its characteristic fossils are scattered through the Clinton rocks.

6. *Salina*, (Onondaga Salt Group.)—This is an important group in the State of New York, containing all the gypsum and water-lime, and furnishing all the salt water of the salines of the city of Syracuse, which produce more salt in a small territory than any other in the world. Its soil is excellent for agricultural purposes, forming, with those south of it, including the Hamilton, the garden-region of the State of New York. The whole group is about 700 feet in thickness, and is divided into five deposits, but there are no well defined lines of division between them, except the last two.

1. The first or lowest is a red shale, showing green spots at the upper part of the mass. The great mass is of a blood red color, fine grained, earthy in fracture, with no regular lines of division, but breaking or crumbling into irregular fragments, and shows but little variation. In several localities the red shale shows numerous green spots, varying from an inch or less to several inches in diameter, which strongly contrast with the red ground on which they are placed. The green color is the result of a chemical change, the peroxide of iron being reduced to protoxide. This red shale is of great extent along the railroad, and presents a thickness of from one to five hundred feet, yet nowhere has a fossil been found in it, or a pebble, or anything extraneous, excepting a few thin layers of sandstone. The main line of the N. Y. C. & H. R. R. R. runs on the *Salina* formation 107 miles, from Canastota to Brighton, and nearly all of this distance on this lower or red shale portion.

2. The second deposit is the lower gypseous shales, the lower part of it alternating with the red shale, which ceases with this mass. This second deposit consists of shales and calcareous slates of a light green and drab color, with alternations of different colored masses, red, green, bluish and yellow, with a little whitish and greenish sandstone, different colors predominating in different places. In this deposit gypsum occurs in fibrous masses, either reddish or of a salmon color, which colors are peculiar to this deposit. The quantity of gypsum in this second deposit is comparatively small, and it is unimportant in an economical point of view.

Both the second and third deposits are permeable to water, which cannot be obtained in any of the hills composed of them unless the wells are sunk to the level of the water-courses, a fact which explains the absence of all brine-springs above the level of the country.

3. The third member of the Salina formation is the gypseous deposit, which embraces the great masses quarried for plaster or gypsum, consisting of two ranges, between which are the hopper-shaped cavities, the vermicular lime-rock, and other porous rocks. This is the most important deposit, not only on account of its plaster-beds, but because it is only in this deposit that we have positive evidence that salt has existed in a solid state, and, therefore, the only source whence the saline springs of Syracuse could have been derived. The great mass of the deposit consists of rather soft yellowish or drab and brownish colored shale and slate, and of more compact masses which are hard, a brownish color predominating. It is usually denominated a gypseous marl, being earthy and indurated, slaty and compact. Some of it when weathered, presents a peculiar appearance, as of having been hacked by a cutting-instrument, with some regularity. The gypsum does not appear in layers or beds, but it occurs in insulated masses, and it assumes irregular not globular forms. The dark color of the gypsum is owing to carbonaceous matter. In many localities there are two ranges of these masses or plaster-beds, generally separated by the vermicular rock and the hopper-shaped cavities. There are two masses of the vermicular rock, the upper one four feet thick, with large porous cavities, the lower one twenty feet thick, with small pores. This vermicular limestone is a porous or cellular rock, resembling lava. It is dark gray or blue in color, and perforated everywhere with curvelinear holes, but otherwise very compact. The holes or cells vary from microscopic size to half an inch in diameter, the cells being very irregular, and communicating with each other, some being spherical, and the resemblance in structure to a porous lava is complete. Forms which are due to common salt have been discovered in this rock, showing the presence of crystals of this substance, which were removed by solution.

The most interesting products of the group are the hopper-shaped cavities, which must have been produced by common salt, as no other soluble mineral presents similar ones. They show conclusively that salt existed in this third deposit. When salt crystallizes, a cube first makes its appearance upon the surface of the brine, then similar cubes form around its border, being attached to its upper surface, near the edges, while it gradually sinks, and additional particles are added, forming another row of cubes upon the first range. This is many times repeated, until the density of the mass formed becomes greater than the liquid, when it falls to the bottom. When examined, being turned upside down, it shows a pyramid of regular steps, terminated by a cube, and when its position is reversed it presents a form like the hopper of a mill. Where two ranges of plaster beds are seen the hoppers occur between them, and between the two masses of vermicular rocks, and are from one inch to three inches and more in diameter. These hopper cavities are formed in the gypseous marl, or in the more solid parts of the vermicular rock. Testaceous animals cannot live in water saturated with gypsum, hence no fossils are found in the deposit. No trace of rock-salt in New York has met the eye of any one, but the existence of it is a matter of no doubt.* The fact of the difficulty of obtaining water in the gypseous hills, in either the second or third deposit, show there is little probability of finding salt above the level of the waters on account of its having long since been dissolved. See Note 27, New York, as to the salt-wells at Syracuse.

*After the above was written, rock-salt was first found, in June 1878, in a boring south of Rochester.

The "Old Road," or the division of the N. Y. C. & H. R. R. R., from Syracuse to Rochester, via Auburn, runs on the gypseous portion of the formation, and the plaster-beds can be inspected at Marcellus station, close to the railroad, but the best gypsum quarries are on Cayuga Lake, just north of Union Springs, the masses being from fifteen to twenty-five feet thick. Sulphuric acid springs, and numerous sulphur springs occur in the State of New York, in the Salina formation, often rising through the crevices of the overlying Water-lime group.

4. The fourth or succeeding portion of the Salina formation, consists of those rocks which show groups of needle-form cavities, placed side by side, caused by the crystallization of sulphate of magnesia, and presenting a finely striated columnar appearance. The rock is a dark gray or drab colored, impure limestone, with cavities containing crystals and often embracing shaly beds. It appears to be a magnesian limestone, its usual color is a brownish drab, also dove color, and it breaks with an earthy fracture.

The Salina formation extends westward across Canada, and the salt-deposits of Goderich in Ontario are in it. Six large beds of rock salt have been found there in boring, measuring in all 126 feet in thickness, at from 1,027 to 1,385 feet in depth from the surface, the beds measuring from 6 feet to 35 feet each in thickness.

The salt-deposits and brine-springs of the world are by no means confined to the Salina formation; on the contrary, they are found in almost all the formations from the oldest to the youngest, and always accompanied by gypsum and red and vareigated marls.

5. The fifth division of the Salina or Onondaga Salt group is the Water-lime, which has generally been considered as belonging to the Lower Helderberg, but which properly is part of the Salina. All the hydraulic cement of the State of New York, known as Rosendale Cement, and Syracuse or Manlius Water-lime, is manufactured from a portion of the stone of this Water-lime formation. It is an earthy, drab-colored limestone and usually consists of two layers of drab limestone, always separated by an intervening mass of blue; it is easily recognized by its gray or ash color when weathered. It has a thickness of not less than 80 feet, and often attains a thickness of 100 feet or more in New York. When the Water-lime is burnt the stone does not slake, if of a good quality. It is ground in a mill, and then it hardens or sets when mixed with water, and remains so under water, its goodness depending on the hardness or cohesion when set. Its peculiar quality is owing to the proportion of silica and alumina it contains. The Water-lime continues across the State of New York, the drab layers which constitute it being always found. The courses into which the layers of Water-lime are sometimes divided show a crenulated or notched surface, like the sutures of a skull, the two surfaces interlocking each other. Professor Hall says the Water-lime is a distinct member, which does not belong to the 7. Lower Helderberg group of strata, but to that below it, the 6. Salina, of which it is the upper member. It is not closely related to either, but more nearly to the Salina, and is much more widely spread than the other members of the Salina. The cement quarries of the Delaware River, between Pennsylvania and New Jersey are in this formation, but cease after passing the Lehigh River westward. The beds near Copley are Trenton or older. In Middle Pennsylvania, where the Salina group, destitute of gypsum and salt, measures 440 feet, the cement beds above measure 580 feet, and the Lewistown limestone (Lower Helderberg) 162 feet, as measured by Ashburner and Billin, in 1876.

7. Lower Helderberg.—In consequence of these rocks being so well developed on the Helderberg Mountains, near Albany, New York, they have received that name. The Lower Helderberg series consists of five limestone sub-divisions, and the Upper Helderberg of four members. They are separated by an important sandstone formation—the Oriskany. The Lower Helderberg, which is well developed in the eastern part of New York, thins out in going west, and at Syracuse disappears entirely. The sandstones also thin out and disappear, so that at Syracuse the Upper Helderberg rests on the Water-lime, the upper member of the Onondaga Salt group. The Lower Helderberg consists, in ascending order, of the 1. Tentaculite limestone, the 2. Pentamerus limestone, the 3. Delthyris shaly limestone, the 4. Encrinal limestone, and 5. Upper Pentamerus limestone.

1. The Tentaculite limestone is the lowest member of the series. Portions of it afford fine building stone, which can be procured in blocks of large size, perfectly solid, and free from cracks or flaws. They vary from ash-gray to black, and present almost every shade between these colors. The strata are intersected by two main systems of joints nearly perpendicular to each other, hence the rock can easily be quarried in large blocks. But much of it is thin-bedded, often thinly laminated, dark blue; its color, texture and composition contrasting strongly with the Water-lime below.—H. The 2. Pentamerus limestone is rarely pure, being more or less mixed with black shale, which gives a dark color to the rock, it being usually a dark gray. It is crystalline in grain, and is in layers, but the lines of division are not straight, and the surface is not even. The whole mass has a rough appearance, and it does not make a good building stone.—V. The 3. Delthyris shaly limestone, as its name implies, is a shaly mass, and consists of alternate beds of shaly and compact limestone. It is an exceedingly interesting rock from the great number of species, the abundance and perfection of its fossils.—Hall, 144. The 4. Encrinal is a compact crinoidal limestone, and the 5. Upper Pentamerus is a bluish gray limestone. In Pennsylvania, according to Rogers, the Lower Helderberg is 50 to 100 feet thick, a diversified calcareous formation, of some shade of blue, argillaceous and flaggy in its lower beds, and shaly towards the middle, with layers and nodules of chert.

8. Oriskany Sandstone.—In New York the greatest thickness of this rock is not more than thirty feet, and usually much less, but in Pennsylvania, Maryland and Virginia it is, in places, as much as 700 feet; even in New York it covers an extensive surface, and is strongly marked in its fossils, which are generally of a large size, and attract the attention of travelers. At the typical locality, Oriskany Falls, the sandstone is twenty feet thick, and is of a light yellow color, friable, and readily crumbling into pure sand; no part of it being sufficiently solid for durable work. One characteristic of this rock is the abundance of small cavities, which have been formed by the destruction of fossils. These present themselves in all cases where the rock is well developed. The porous nature of the mass has admitted the percolation of water, which has dissolved the calcareous matter of the shells, usually leaving casts of their internal structure. As a mass the Oriskany sandstone is a coarse, rather loosely cemented, purely silicious sandstone, of a yellowish white color. Sometimes it is shaded brown or some other dark color. In Pennsylvania it forms rough ridges, with a poor sandy soil. It is used for glass-making, and contains an iron-ore too silicious to be valuable. Some of our geologists (Hall, Rogers, Dana, etc.) place the Oriskany at the top of the Silurian series, and others (Newberry, Lesley, Hunt, etc.) at the bottom of the Devonian.

9-12. DEVONIAN AGE.

9. LOWER DEVONIAN.

9 Upper Helderberg or Corniferous.—This very widely extended formation consists of four important members, the Cauda-galli, the Schoharie grit, the Onondaga limestone, and the Corniferous limestone, the upper member. But in the recent text-books on geology the whole formation is called the Corniferous, which was the name given by Eaton to the whole formation of limestone. It forms the Helderberg range, a high ridge which extends through the State of New York, forming a very rich and productive tract of country. This group of strata, as above limited, and designated the Upper Helderberg by Professor James Hall, is, in his opinion, deserving of recognition as the base of the Devonian, the Hamilton group being the middle, and the Portage, Chemung and Catskill the Upper Devonian.

9 a. Cauda-galli.—This is a fine-grained calcareous and argillaceous sandstone, usually drab and brownish, and blanching by long weathering. It readily strikes the eye by its contrast with its associated rocks, and by the singular marking of impressions strongly resembling the tail of the common barn-yard fowl, from whence its Latin name of Cauda-galli or cock's-tail. Its fossils have been found in New York and at Crab Orchard, in Kentucky. In New Jersey, northeast of the Delaware Water Gap, this and the Schoharie are three hundred feet thick.

9 b. Schoharie Grit.—This is very much like the preceding, but altogether different in its fossils. It is a fine-grained, very calcareous grit, or an arenaceous limestone, naturally brown, but weathering to a gray or drab color, containing a great number of fossils peculiar to this stratum, and is found in the mountain one and one-half miles northwest and northeast of Schoharie, New York, and extends by the Helderberg range to Kingston. The Schoharie Grit is a highly fossiliferous formation, and has a wide geographical extension. Its great number of cephalopods gives it a marked character, but it contains other fossils identical with the limestones above.—H.

The **9 c. Onondaga Limestone** in New York rarely exceeds ten to fourteen feet in thickness, but is very persistent, and is readily recognized by its light gray color, crystalline structure, toughness, and its numerous organic remains. This is one of the most valuable building stones in the Helderberg division, and has been largely quarried near Syracuse for the canal. It is an imperishable stone, having great power to resist the action of air, water and frost. It is generally the rock over which the water flows at the water-falls on the Helderberg range, as at Perryville and Chittenango Falls, and is remarkably uniform in its character. It is more extensive than the Corniferous proper, and it is very rich in beautiful and characteristic fossils. The limestones used for flagging in Syracuse are Onondaga limestone, brought from the typical localities Onondaga Valley and Split-Rock on Onondaga Hill. When wet they make a fine display of fossils of this formation. This stone is also used for building everywhere in Central New York.

9 d. Corniferous Limestone.—For all practical purposes, this and the Onondaga limestone may be regarded as one formation. It extends from the Hudson River to the Niagara River, which it crosses at Black Rock, producing there a rapid current at the International Bridge, at Buffalo, and forming a small island just above the water. It extends far into Canada, is seen at Sandusky City, Ohio, and there forms the bottom of Lake Erie. Its color varies from a light grayish-blue to a black, and is sometimes even a light gray or drab. It contains numerous nodules of flint or hornstone, from which it derives its name. But few if any of the layers afford a pure limestone. Its color varies from black to gray, brownish and light blue. It is usually in regular courses from six to eighteen inches thick, separated by layers of hornstone, and sometimes embracing flattened nodules of the same. This rock is crossed by vertical joints in two directions, giving rise to numerous copious springs of water. An upper division, called the Seneca limestone, is now included in the Corniferous. In New Jersey and Pennsylvania it is a blue and sometimes sparry limestone, including bands and nodules of chert. In Canada and the Western States it is a straw-colored and light gray rock. In its general eastern exposures it is generally bluish. Above the Corniferous are no general limestone masses in the Eastern States, but partial deposits only, the most extensive of which is the Tully limestone, found only in Central New York. There is an astonishing change from the top of the Corniferous limestone to the black shales of Marcellus. Two formations more unlike cannot anywhere be found. Both the Corniferous and Onondaga are included in the Upper Helderberg limestone of Pennsylvania, and on the Juniata they measure together only sixty feet. Immediately upon the upper surface of the Corniferous limestone, lies the valuable and extensive MARCELLUS IRON ORE. This consists of carbonate of iron, which occurs in a bed of pyritous clay, and near the outcrop is changed into limonite.

10. MIDDLE DEVONIAN.

10 a. Marcellus Shales are of a black color, usually dark brown when altered. They greatly resemble the Utica slate in mineral character, and could readily be mistaken for it. They extend in New York from the Hudson River to Lake Erie. The lower part contains some impure black limestone, not in layers or beds, but in interrupted flattened masses. The upper shales are not so highly colored as the lower ones, and are disposed to separate, when long exposed, into small, thin-edged fragments, the result of a peculiar accretionary structure. The fragments often exhibit stains, in spots, from iron rust, and also minute crystals of gypsum, the effect of the action of decomposed pyrites and limestone particles. Some portions of the lower shales are black and friable from small carbonaceous fucoids. Along the whole line of its outcrop it has been dug into in vain attempts to find coal.—Van U. 147. It has two joint planes, nearly at right angles to each other, causing projecting corners of rock, with smooth nearly vertical surfaces. These are sometimes seen in the upper members also of the Hamilton group, and the *septaria* or flattened balls of black limestone also occur in the Genesee shales.

The lower part is very black, slaty and bituminous, and contains iron pyrites in great profusion. In general character the lower part resembles the Utica slate and is not distinguishable from the 10 c. Genesee slate, in its general aspect. When long exposed, the lower part weathers to a brownish or iron-rust color, partly from the presence and decomposition of iron pyrites and partly from bituminous matter. In some situations it retains its purely black color, and scarcely separates

into thin laminae after long exposure. In many places this rock contains so much bitumen as to give out flame when thrown upon a fire of hot coals. In Western New York it is fifty feet thick, and farther east much thicker.—H.

This important formation carries its broad black outcrops across many of the Middle and Southern States, with comparatively little change, but in the South the black shale is supposed to be Genesee. In the Juniata region of Pennsylvania the Marcellus has been found to measure 875 feet thick, and is there divisible into an upper, middle and lower member, the last consisting of black and brown shales, the surface being stained with iron rust, &c., coated with bituminous matter. In Perry County, Pennsylvania, small coal beds occur in this formation, constituting the oldest known coal-measures, and significantly marking the great change in the general condition of things which either followed or was introduced by the deposit of the Oriskany sandstone.—Lesley.

In speculating upon the origin of petroleum, some geologists have sought it in a process of distillation from the black Marcellus and Genesee shales upward, and of condensation in the oil-bearing gravels and fissures of the overlying formations. Chemists, like T. Sterry Hunt, oppose this view on chemical grounds, others oppose it from other considerations of apparently equal weight. It is a curious fact, however, that at this horizon, and in the Upper Helderberg or Corniferous, occur the petroleum deposits of Upper Canada, while the Pennsylvania oil-deposits lie at successively higher and higher stages in the series.

10 b. Hamilton.—This group takes its name from the town of Hamilton, in Madison County, New York, which contains no other rock, and where the best opportunity exists of examining the members of which it is composed, and where its fossils are in great abundance. It includes all the masses between the upper shales of Marcellus, and the Tully limestone, and is from 300 to 700 feet in thickness in New York. It is important from its fine agricultural qualities, its thickness and extent, commencing at the Hudson and extending to Lake Erie. It consists of slate, shale and sandstone, with endless mixtures of these materials, or, in other words, sandy shale and shaly sandstones, and is not very easily described. There are three distinct mineral masses as to kinds, but not as to arrangement. The first, in the order of the tenuity of particles, is rather a fine grained shale, often fissile or slaty, its color some shade of blue, usually dark or blackish. The second is a coarse shale, often mixed with carbonate of lime, its color blue or dark gray when fresh, but becoming of an olive or brown color by long exposure to the weather, the color being due to manganese. It has no tendency whatever to separate into regular layers, but when a mass has been long exposed it shows numerous curved divisions, the curves very short and irregular, giving it a very peculiar appearance, which is unmistakable. The third kind, which is not so common as the two first, is a well characterized sandstone, and is generally in the upper part of the group, but more or less mixed with either of the two others. It is often in layers, though rarely straight, and usually short, interrupted, sometimes mixed with carbonate of lime. The colors of this kind are of more various shades, olive, greenish and yellowish. One thin layer produces excellent flagstones, but the group generally is deficient in building materials, the shale of the first kind readily crumbling by exposure to the air; the two latter kinds alone furnishing building stone. The best is where limestone forms the cement, and sand is in the

greatest abundance. So rare is the occurrence of regular layers in the group, that their absence is a good negative character, and its brownish or yellowish color, externally, or where weathered, a good positive one of the group generally. This applies to the central, but not to the eastern part of the State of New York. It abounds in fossils, and is admirably characterized by them, numerous species and even genera commencing with the group, and ending with it.—Van U. 150.

In the western part of the State of New York, instead of sandy shale and shaly sandstone, and even tolerably pure sandstone, as in the east, the sand has diminished and the clay increased. The group, as a whole, presents an immense development of dull olive, bluish-gray calcareous shales, which, on weathering, assume a light gray or ashen tint, some thin portions becoming brownish on exposure. The formation thins out very much in going westward, and at Lake Erie has only half the thickness found at Seneca Lake, and is so different that doubt of the identity of the two might arise, if one judged by the appearance only. The Hamilton is the New York lake formation, the following lakes being excavated in it: Otsego, Cazenovia, Skaneateles, Otisco, Owasco, Cayuga, Seneca, Canandaigua, and the north end of Hemlock Lake. The east end of Lake Erie is also cut out of the Hamilton. The upper part of the Hamilton was called the Moscow shale, from a place between Mt. Morris and Rochester, on the Genesee River.

In Pennsylvania the Hamilton shale has been measured on the Juniata, 635 feet thick. It has many hundreds of miles of outcrop, in repeated zig-zags, forming, in combination with the Genesee and Portage above it, ranges of smooth, cultivated hills, of an entirely characteristic shape, in long lines of ruffled slopes, regularly indented with short and smooth ravines. This striking topographical feature, maintains itself throughout the mountain-region into Virginia, and still farther south. The abundance of shells, without limestone beds, in Pennsylvania, furnishes a partial clue to the deposit of the (next succeeding) Tully limestone in New York.

10 b. Tully Limestone.—This is the dividing line, easy to find, between the Hamilton and Genesee, being the upper part of the former, and it is important in New York as the most southern mass of limestone in the State. It is only local, and is an impure limestone, fine-grained, usually a dark or blackish blue, often brownish. The usual thickness of the rock is about fourteen feet, and its greatest thickness twenty feet. It makes a good but not a white lime. It receives its name from the township of Tully, in Onondaga County, New York. This limestone often shows an accretionary structure, and a roughed, notched appearance, where its layers separate as in some of the layers of the water-lime. One of the lower layers is thick, the bottom one being frequently five feet in thickness, and it is owing to this circumstance, and to the softness of the shale beneath, that whenever a waterfall exists, the shale has been washed out to some depth, leaving a chamber or cavern, of which the limestone forms the roof or ceiling.—V. 169. It is a marked geological horizon in Central New York, being the termination of the Hamilton, and is succeeded by shales of a widely different character. It is often thick-bedded, but it is often divided by numerous irregular seams into small fragments. Its color, on first exposure, is blue or nearly black, but weathers to an ashen hue. It is best seen on the Cayuga Southern R. R., where it stands out in the face of the cliffs as a prominent band. It is absent west of Canandaigua Lake and in the eastern part of the state.—H. 212.

10 c. Genesee, (Black Slate of the west and south).—This is a great development of argillaceous fissile black slate. Where its edges only are exposed, it withstands the weather for a great length of time, and often presents mural banks in the ravines, river-courses, and upon the shores of lakes. When the surface of the strata is exposed it rapidly exfoliates in thin even laminæ. On disintegration it is often stained with iron, owing to decomposition of pyrites, but in many instances, and the greater number of localities, it retains a deep black color. In this it is distinguished from some beds of black slate in higher situations, which always become stained with hydrate of iron on their edges, and upon the surface of the laminæ. In color and general character it greatly resembles the Marcellus shale, and, aside from position, it would be difficult to distinguish the two, in the absence of fossils. It forms no conspicuous feature in the scenery or topography of the general surface. In ravines, and river and lake banks, it is usually seen in connection with the rocks below or above. Its greatest development, and a point where it appears more prominently alone, and the typical locality from which it was named, is at the opening of the gorge of the Genesee, at Mount Morris, where it is seen in the perpendicular cliffs for more than a mile in length. See note No. 112, New York. Another great exposure of the Genesee slate is along the Cayuga Southern Railway south of Ludlowville, where it shows from eighty to one hundred feet thick, with the Tully limestone below and the Portage shales above it. See note 83, New York. The mass decomposes much less rapidly than the soft calcareous Hamilton or Moscow shales below it, and the thin slaty laminæ resist atmospheric action a long time. In lithological character it is entirely uniform, having, from Cayuga Lake to Lake Erie, the same deep black color and laminated slaty structure, nor is there any change in its organic remains. Its fossils in Indiana are precisely identical with those of New York.—Hall 218.

There are few formations in Central New York of which the limits are so well defined as this, lying between the Tully limestone below, and the sandstone flags of the base of the Portage group, above. It may also readily be found by the black color and slaty fracture. This shale has been regarded as the main original source of the petroleum in the oil region of Ohio and Western Pennsylvania, but there is reason to believe that part, at least, of the supply of these regions has come from the Corniferous limestone below it, as maintained by Dr. Hunt.

All through the western and southwestern states there is always found a **BLACK SHALE**, which is often the only representative of the Devonian rocks. This is generally considered to be 10 c. Genesee. It is very remarkable that a formation of its composition, of so inconsiderable a thickness, and otherwise so unimportant, should be so widely extended, and retain throughout its character unchanged as a black shale. The researches of Dr. Newberry in Ohio tend to show its fossils to be of the Portage type. It is there 350 feet thick, and he pronounces it to be the equivalent of the Genesee and lower Portage. All the divisions of the Hamilton group, Marcellus, Hamilton and Genesee, are converted, by exposure, into a deep soil of an excellent quality for agricultural purposes, sometimes quite hilly, but forming smooth land free from stones. Some of the finest wheat-growing and hop-raising land in New York is on the Hamilton, and its rich shales have been carried south by drift and diluvial agencies, and spread over the Genesee, Portage and Chemung, greatly to their improvement.

11-12. UPPER DEVONIAN.

11 a. *Portage*.—This group represents an extensive development of shales and flagstones, and finally some thick-bedded sandstone towards its upper part. It is extremely variable in character at different and distant points. In New York the Portage rises sometimes in a gentle slope, and at other times abruptly from the softer shales below. Between the deep north and south valleys, in which the railroads run, the enduring sandstones of the upper part extend far northward, presenting, on the north side, a gentle slope, while on the east and west sides of the same hills, the slope is abrupt, the valleys being bounded by steep hills. *The change in the external appearance of the country indicates the commencement of these Portage rocks, although they are not seen.* Throughout the Hamilton shales, the valleys present gently sloping sides, and the country rarely rises far above the valley bottom. But on approaching the northern margin of the Portage group, the railway traveler sees a gradually increasing elevation of the hills on either side, and an abruptness in their slope, and in a short time finds himself in a deep valley bounded on either side by hills rising 400 or 500 feet, and in some instances, even 800 feet above the bed of the stream. These elevations often extend several miles unbroken, except by the deep ravines which indent their sides. The higher sandstones of the group, and in many instances the intermediate ones, produce falls in the streams which pass over them, and some of the most beautiful cascades in the State of New York, and many of the highest perpendicular falls of water, are produced by the rocks of this group, and in none others do we meet with more grand and striking scenery.—J. Hall's Report.

The pedestrian often finds his course impeded by a gorge of several hundred feet in depth, such as Watkins Glen and Havana Glen. The Portage upper, middle and lower falls are 66, 110 and 96 feet, and between the middle and lower the rocks rise in perpendicular cliffs 351 feet in height. See note No. 110, New York, as to Portage on Erie Railroad. Taghanic, Hector, and Lodi falls are also in the Portage. These points afford some of the grandest views of scenery, and admirable facilities for geological investigations. The lower division of the Portage is the 1. *Chasagua shales*, a green shale, with thin flagstones, and sandy shale. 2. The middle portion is the *Gardeau shale* and flagstones, a great development of green and black slaty and sandy shales, with thin layers of sandstone, from which are quarried beautiful and durable flagstones. The rocks of this part of the group form high, almost perpendicular, banks on the Genesee. In a westerly direction the sandstones disappear, and the shales increase. 3. The upper part of the Portage consists of the *Portage* sandstones, thick bedded sandstones, with little shale, while below, the sandy layers become thinner, and shale beds more frequent; still it must be acknowledged that there is no abrupt change from the beginning of the Portage to the top of the Chemung. In the Portage, the sandstones and shales are less separated than above, and the sandy strata are finer grained, and contain more lime than in the Chemung. Towards the southern extremity of Cayuga and Seneca Lakes, the Portage rocks form cliffs of considerable height, which present alternating hard and soft layers, and the numerous vertical joints present the appearance of solid walls of masonry, in distinct and regular courses. The vertical joints are well seen in Havana Glen. Isolated masses, like huge columns, are often seen, standing out in bold relief from the line of the cliff, being the remains of previously exposed surfaces, which

had crumbled away. On the Genesee River the group is not less than 1000 feet thick. The Portage yields less lime to the soil than the Hamilton, but for pasturage it is superior to it.—H. 224. The great dairy-country of Cortland, and other counties in Central New York, is on the Portage formation. The water of the Portage group is remarkably pure and soft. The Portage rocks have not been recognized in the eastern part of New York. In Ohio the Portage forms the upper part of the Huron shale, and the lower part of the Erie shale, of Dr. Newberry.

In Middle Pennsylvania, according to Lesley, the Portage flags are 1,450 feet thick, and the Chemung shales over them, 1,860 feet thick. It is very hard to draw a line of demarcation between them, but, as a whole, the Chemung strata are more silicious and the Portage more argillaceous. The Portage sandstones are flaggy, and, at times, very shaly, and their alternations with shale frequent, the individual beds being thin, and the shales predominant. The Chemung sandstones are more massive, ferruginous and micaceous, with fewer alternations of shale. Brachiopods and other shells are abundant in the upper Chemung shales, while the Portage rocks are almost destitute of animal forms except crinoids and fucoids. Fucoidal impressions are also very abundant in the upper Chemung, and to the decomposition of this abundant marine vegetation, Lesquereux and others ascribe the origin of the petroleum, at its various local horizons, from the Portage up to the Mahoning sandstone in the Coal Measures.

11 b. Chemung.—These rocks can everywhere be described as a series of thin-bedded sandstones and flagstones, with intervening shales, and mixtures in various proportions of these, and very rarely beds of impure limestone, resulting from the aggregation of organic remains. The whole series weathers to a brownish olive, and even the deeper green of the shales assumes that hue. The shales vary in color from a deep black to olive and green, with every grade and mixture of these. The sandstones are often brownish-gray or olive, and sometimes light gray. More generally, however, there is a tinge of green or olive pervading these strata. Towards the upper part of the group, in some localities, there is a tendency to conglomerate, and in a few places the mass becomes a well defined pudding-stone, with sometimes 150 to 200 feet of Chemung shales and sandstones above it. Towards the upper part of the group the shales are reddish, coarse and fissile, with much mica in small glimmering scales.—Hall 251. From their red color these have sometimes been mistaken for the Catskill formation.

In a few localities in Pennsylvania it contains a very excellent variety of iron ore. As a general thing, however, this formation, and all others above it, up to near the coal conglomerate, are singularly deficient in iron ore. There is little of geological interest throughout the whole extent of the Chemung group. The N. Y. L. E. & W., or Erie Railway, runs for 800 miles west of Susquehanna on this formation, and on nearly the same portion of it. In the northwestern portion of Pennsylvania the celebrated oil region is in the Chemung, the oil being found stored-up in certain coarse porous sandstones, but these are merely the repository of the oil originating in lower strata. It is a very extensive formation in Southern New York, all the southern tier of counties, west of Great Bend, being covered by it, and it forms an excellent grazing and agricultural country, not quite equal to the Portage, but much superior to the Catskill. In Northern Pennsylvania this formation, as in Southern New York, consists of a vast succession of thin layers of shale, of every hue, from a deep olive and dark green to a light slaty gray, alternating with thin beds of brownish gray sandstones.

11-12. UPPER DEVONIAN.

11 a. **Portage.**—This group represents an extensive development of shales and flagstones, and finally some thick-bedded sandstone towards its upper part. It is extremely variable in character at different and distant points. In New York the Portage rises sometimes in a gentle slope, and at other times abruptly from the softer shales below. Between the deep north and south valleys, in which the railroads run, the enduring sandstones of the upper part extend far northward, presenting, on the north side, a gentle slope, while on the east and west sides of the same hills, the slope is abrupt, the valleys being bounded by steep hills. *The change in the external appearance of the country indicates the commencement of these Portage rocks, although they are not seen.* Throughout the Hamilton shales, the valleys present gently sloping sides, and the country rarely rises far above the valley bottom. But on approaching the northern margin of the Portage group, the railway traveler sees a gradually increasing elevation of the hills on either side, and an abruptness in their slope, and in a short time finds himself in a deep valley bounded on either side by hills rising 400 or 500 feet, and in some instances, even 800 feet above the bed of the stream. These elevations often extend several miles unbroken, except by the deep ravines which indent their sides. The higher sandstones of the group, and in many instances the intermediate ones, produce falls in the streams which pass over them, and some of the most beautiful cascades in the State of New York, and many of the highest perpendicular falls of water, are produced by the rocks of this group, and in none others do we meet with more grand and striking scenery.—J. Hall's Report.

The pedestrian often finds his course impeded by a gorge of several hundred feet in depth, such as Watkins Glen and Havana Glen. The Portage upper, middle and lower falls are 66, 110 and 96 feet, and between the middle and lower the rocks rise in perpendicular cliffs 351 feet in height. See note No. 110, New York, as to Portage on Erie Railroad. Taghanic, Hector, and Lodi falls are also in the Portage. These points afford some of the grandest views of scenery, and admirable facilities for geological investigations. The lower division of the Portage is the 1. *Ohasagua shales*, a green shale, with thin flagstones, and sandy shale. 2. The middle portion is the *Gardeau shale* and flagstones, a great development of green and black slaty and sandy shales, with thin layers of sandstone, from which are quarried beautiful and durable flagstones. The rocks of this part of the group form high, almost perpendicular, banks on the Genesee. In a westerly direction the sandstones disappear, and the shales increase. 3. The upper part of the Portage consists of the *Portage* sandstones, thick bedded sandstones, with little shale, while below, the sandy layers become thinner, and shale beds more frequent; still it must be acknowledged that there is no abrupt change from the beginning of the Portage to the top of the Chemung. In the Portage, the sandstones and shales are less separated than above, and the sandy strata are finer grained, and contain more lime than in the Chemung. Towards the southern extremity of Cayuga and Seneca Lakes, the Portage rocks form cliffs of considerable height, which present alternating hard and soft layers, and the numerous vertical joints present the appearance of solid walls of masonry, in distinct and regular courses. The vertical joints are well seen in Havana Glen. Isolated masses, like huge columns, are often seen, standing out in bold relief from the line of the cliff, being the remains of previously exposed surfaces, which

had crumbled away. On the Genesee River the group is not less than 1000 feet thick. The Portage yields less lime to the soil than the Hamilton, but for pasturage it is superior to it.—H. 224. The great dairy-country of Cortland, and other counties in Central New York, is on the Portage formation. The water of the Portage group is remarkably pure and soft. The Portage rocks have not been recognized in the eastern part of New York. In Ohio the Portage forms the upper part of the Huron shale, and the lower part of the Erie shale, of Dr. Newberry.

In Middle Pennsylvania, according to Lesley, the Portage flags are 1,450 feet thick, and the Chemung shales over them, 1,860 feet thick. It is very hard to draw a line of demarcation between them, but, as a whole, the Chemung strata are more silicious and the Portage more argillaceous. The Portage sandstones are flaggy, and, at times, very shaly, and their alternations with shale frequent, the individual beds being thin, and the shales predominant. The Chemung sandstones are more massive, ferruginous and micaceous, with fewer alternations of shale. Brachiopods and other shells are abundant in the upper Chemung shales, while the Portage rocks are almost destitute of animal forms except crinoids and fucoids. Fucoidal impressions are also very abundant in the upper Chemung, and to the decomposition of this abundant marine vegetation, Lesquereux and others ascribe the origin of the petroleum, at its various local horizons, from the Portage up to the Mahoning sandstone in the Coal Measures.

11 b. *Chemung*.—These rocks can everywhere be described as a series of thin-bedded sandstones and flagstones, with intervening shales, and mixtures in various proportions of these, and very rarely beds of impure limestone, resulting from the aggregation of organic remains. The whole series weathers to a brownish olive, and even the deeper green of the shales assumes that hue. The shales vary in color from a deep black to olive and green, with every grade and mixture of these. The sandstones are often brownish-gray or olive, and sometimes light gray. More generally, however, there is a tinge of green or olive pervading these strata. Towards the upper part of the group, in some localities, there is a tendency to conglomerate, and in a few places the mass becomes a well defined pudding-stone, with sometimes 150 to 200 feet of Chemung shales and sandstones above it. Towards the upper part of the group the shales are reddish, coarse and fissile, with much mica in small glimmering scales.—Hall 251. From their red color these have sometimes been mistaken for the Catskill formation.

In a few localities in Pennsylvania it contains a very excellent variety of iron ore. As a general thing, however, this formation, and all others above it, up to near the coal conglomerate, are singularly deficient in iron ore. There is little of geological interest throughout the whole extent of the Chemung group. The N. Y. L. E. & W., or Erie Railway, runs for 300 miles west of Susquehanna on this formation, and on nearly the same portion of it. In the northwestern portion of Pennsylvania the celebrated OIL REGION is in the Chemung, the oil being found stored-up in certain coarse porous sandstones, but these are merely the repository of the oil originating in lower strata. It is a very extensive formation in Southern New York, all the southern tier of counties, west of Great Bend, being covered by it, and it forms an excellent grazing and agricultural country, not quite equal to the Portage, but much superior to the Catskill. In Northern Pennsylvania this formation, as in Southern New York, consists of a vast succession of thin layers of shale, of every hue, from a deep olive and dark green to a light slaty gray, alternating with thin beds of brownish gray sandstones.

In Pennsylvania, ninety feet of strata have been carefully studied and measured on Sideling Hill, consisting of alternate beds of red and olive shales and sandstones with Chemung fossils, ripple-marks and fucoids, and a bed of iron ore long known by the name of the Larry's Creek ore, which outcrops everywhere along the face of the Allegheny Mountain. In the gaps at Blairsville and Connellsville, in Southwestern Pennsylvania, Prof. Stevenson finds Chemung fossils in what have always been called the Catskill rocks, on account of their being of a red color, and other geologists have made the same observation in Northern Pennsylvania. In Southern New York, adjacent to Pennsylvania, Professor Hall reports 150 feet of red rocks, and then thin gray rocks above with Chemung fossils.

The Erie shale of Ohio is the equivalent of the 11 b. Chemung, and the upper part of the 11 a. Portage. At Cleveland, it consists of green, gray and blue shales—soft and fine, with sheets of micaceous, silvery sandstone, from half an inch to two inches in thickness, and flattened masses of argillaceous iron ore.—Newberry. The formation also occurs in Kentucky, and Chemung fossils have been found in Utah and Nevada by Clarence King and Arnold Hague.

12. Catskill.—There is no observable line of demarcation between the Chemung and Catskill. The first sign of change is a more solid or hard rock appearing, often accompanied by red sandstone or red shale. The group consists of light colored gray sandstone, usually hard; of fine-grained red sandstone, red shale or slate; of dark colored slate and shale, of grindstone-grit, and a peculiarly accretionary and fragmentary mass, appearing like fragments of hard slate cemented by limestone, similar to what is well known in England as cornstone. The hard gray sandstone often presents a highly characteristic structure, the layers, one or more inches thick, being disposed in oblique divisions, the divisions usually overlapping each other. This peculiar angular arrangement presents altogether a singular conformation, and forms a highly picturesque rock.—V. You can see this at Ralston, Pennsylvania.

The prevailing color of the sandstone is brick-red, though often it is lighter, and sometimes of a deeper color, from a larger proportion of iron, while the coarser parts are often gray, and the shales are green. Beds of green shaly sandstone are interstratified with the red friable sandstone, and these are succeeded by a compact kind of conglomerate rock. The formation expands, and augments in thickness, in passing eastward, till it finally rises in the high and prominent peaks of the Catskill Mountain, nearly 4,000 feet above the sea, from which the formation derives its name. See note No. 9, of New York.

The formation extends from this locality southwestward into Pennsylvania, where its outcrop, 3,000 feet thick, in combination with that of the Pocono sandstone above it, 2,000 feet thick, forms a terraced mountain, which surrounds each of the Anthracite coal fields; the red rocks of the Catskill making the terrace, and the white rocks of the Pocono forming the crest. Piled upon one another in inclined strata, they constitute the bulk of the Catskill Mountains in New York, of the Pocono plateau in Pennsylvania, and the Allegheny, Savage and Cumberland Mountains, far into Virginia and Tennessee.

In all the railroads approaching the anthracite coal regions of Pennsylvania one passes over these Catskill rocks, often for many miles. They contain no coal, but fossil ferns are abundant in some localities. This is the last and upper formation of the Devonian period, and is the foundation on which rests the carboniferous

system. On the Delaware division of the N. Y. L. E. & W., or Erie Railway, is an opportunity of seeing the red rocks of the Catskill formation for a number of miles, and also on the N. Y. & O. Midland Railroad north of the Bloomingburgh tunnel.

In Pennsylvania it is composed of a vast succession of thin-bedded red and gray sandstones, with thin seams of red, green and mottled shales, also coarse and fine sandstones of various hues of red, brown, gray and greenish; together with red and greenish coarse silicious conglomerate of white quartz pebbles, the whole being thick bedded, and with an oblique laminated structure. It has not much of interest, either to the scientific or practical inquirer. Its most interesting fossils are fish-remains, which, in the Catskills, extend through 100 feet in thickness of strata. It is the *Old Red sandstone* of England, lying under the coal. The English *New Red sandstone* is over the coal, being the Permian, Jurassic and Triassic formations, but these are not found directly over the coal in America.

The Catskill formation is a poor one for agricultural purposes. The fields are stony, with many projecting ledges of red rocks. Its sandstones are too hard, and too destitute of lime to produce a fertile soil, and the country covered by it is either a wilderness, or very thinly populated.

13-15 CARBONIFEROUS AGE.

13 a. Lower Sub-Carboniferous.—To a superficial observer, the remarkable substitution of great sandstone and conglomerate deposits, under the coal-measures in the east, for generally limestone deposits, under the coal-measures of the west, must seem inexplicable. But the simple explanation is, that all the sub-carboniferous sand-beds of Pennsylvania, formed near the old continent, thin away, and gradually disappear, before they reach the Mississippi; while the five great sub-carboniferous limestones of Illinois, Iowa, and Missouri, formed in a deep quiet sea, on the contrary, thin away, in going eastward, to 40 feet in Westmoreland County, and 25 feet in Somerset County, Pennsylvania; and totally disappear before reaching the Schuylkill and Lehigh Rivers. But the same limestone deposits thicken southward to 600 and 1,000 feet in Virginia, and even more in Tennessee.

In the Pennsylvania Anthracite country, the next formation above the Catskill is a gray sandstone, called by Prof. H. D. Rodgers the Vespertine. In the second geological survey, Prof. Lesley calls it the Pocono, from the name of the mountain bounding Wyoming Valley, on the south side. The miners call it the second conglomerate. It contains carboniferous fossils, but no coal of value. Invariably the Vespertine is the outside mountain surrounding the coal-basins, the inside one being the 14 a. Pottsville conglomerate, or Millstone grit, and they are separated by 13 b. Mauch Chunk red shale, of Lesley, or Umbral, of Rogers, a soft rock, which forms a valley; and all four, 12. Catskill or Ponent, 13 a. Vespertine or Pocono, 13 b. Umbral or Mauch Chunk, and 14 a. Seral or Pottsville conglomerate, are worthless for farming purposes.

In Pennsylvania, the Vespertine is a white, gray and yellowish sandstone, alternating with coarse silicious conglomerates, and dark-blue, olive and black slates, and occasionally thin beds of coal. In Michigan, it is the Marshall group, which is mostly a somewhat friable rock, with a reddish, buffish, or olive color, though in some regions becoming gray or bluish-gray. It forms the receptacle into which the brine descends, and accumulates from the next over-lying Michigan salt group, which is 18 b., and also sub-carboniferous. The Waverly group of Ohio is proved, by its fossils, to be of this same age. Its sub-divisions are given at the head of the chapter on Ohio. It produces the Berea grindstones and Waverly sandstone, the finest building-stone in Ohio, if not in the United States. In Tennessee there is a great development of the lower sub-carboniferous group, the 13 a. Barren group, and 13 b. Coral, or St. Louis limestone, formerly called by Prof. Safford the Silicious. Its upper part is the equivalent of the St. Louis limestone of Missouri; the lower is a series of silico-calcareous rocks, characterized by heavy layers of chert, one inch to two feet thick.

In Illinois the series of sub-carboniferous strata consists of the 1. Kinderhook group, 2. Burlington group, 3. Keokuk group, 4. St. Louis group, the base of which was formerly called the Warsaw limestone, and the 5. Chester group; all of these are limestones and shale, with some sandstone in the first and last named. These embrace both the lower and upper sub-carboniferous, and are 1,200 to 1,500 feet thick in the south-western part of Illinois, but thin-out in going north, and entirely disappear before reaching Rock Island, where the coal-measures rest on the Devonian limestone. In Iowa the four lower members occur, but the Chester, the thickest member, is wanting, and it is almost entirely wanting in Missouri.

In Pennsylvania a small coal-bed has been opened on the Susquehanna River, in the Pocono sandstone; and in Huntingdon County more than a dozen small layers of coal may be traced, running through the formation. In Montgomery County, Virginia, two similar coal-beds attain a local importance, being on Tom's Creek, respectively 4 and 8 feet thick. These represent the lower coal of East Kentucky, Tennessee, and Alabama.

In Ohio the Subcarboniferous limestone extends through some of the south-eastern counties. It is quite thin, and represents only the upper or Chester member of the group. Two workable seams of coal—the Jackson and Wallston coals—are found below it.—Newberry.

13 b. Upper Sub-Carboniferous.—In Pennsylvania this is the Umbral red shale of Rogers, and the Mauch Chunk of Lesley, sometimes 3,000 feet thick, and here consists almost entirely of very soft red shales and argillaceous red sandstone, without fossils. It gradually becomes in Virginia a triple mass of buff, green and red shales below, a thick body of light-blue limestone, full of fossils, in the middle, and the upper part blue, olive and red calcareous shales, with massive strata of gray and brownish sandstone. It contains beds of iron ore, which are sometimes very valuable. In the Western States the limestone is the principal rock. It is the limestone of Greenbriar Valley in West Virginia. In Northern Pennsylvania, gray and greenish shales, and gray argillaceous sandstones, are introduced among the red shales, and farther west it consists of two or more strata of soft red shales, separated by a thick body of gray, flaggy sandstone. It is generally well marked in Pennsylvania as the softest of rocks, or simply dry red mud, and is to be noticed by those in search of coal, none of which is ever found in or below it. In Tennessee this formation is the mountain limestone,

beneath the coal-measures. It is a heavy body of limestones and shale, the latter almost one-fourth of the mass; and there is also a sandstone. See the above description of 18 a. in Illinois.

In Middle Pennsylvania, around the Broad Top coal-basin, Prof. J. P. Lesley says there appears, for the first time in this formation, going west, distinct traces of the great mountain limestone formation, which underlies all the southern and western coal-fields, and becomes one of the principal features of the geology of the Rocky Mountains, as it is also of the geology of Europe. The red shale formation is here seen, divided in two—910 feet of it above, and 141 feet of it below; a middle group of red and gray, mottled calcareous shales, and thin limestone layers, full of fossil shells—in all 49 feet thick—separating the upper and lower members of nearly pure red shale.

The narrow red shale valleys, which surround this Broad Top coal-basin, the Cumberland basin in Maryland, and the three principal groups of anthracite basins in Eastern Pennsylvania, are due to the thickness and softness of this important formation. But while it is 8,000 feet thick at Pottsville, it is but 800 feet thick along the Allegheny Mountain, and less than 100 feet thick around the coal-basins of Tioga and Bradford counties; and, therefore, instead of making valleys, only marks the top of the mountain steep slopes with a narrow terrace, over which dominates the vertical cliffs of the outcrop of the coal conglomerate.

14 a. Millstone Grit.—This is a mass of white or yellow sandstone, containing vast numbers of quartz pebbles, and forming a pudding-stone, or conglomerate. It is called the Millstone Grit, from being used for the manufacture of millstones. In Pennsylvania and Virginia the formation is 1,000 feet thick, but becomes reduced to from 10 to 175 feet in Ohio. In Kentucky it is from 50 to 500, and in Indiana from 50 to 100 feet. It is a very peculiar rock, and very wide spread, extending out beyond the coal measures proper, of which it is the base and support. There is not in the entire geological series, says Dr. Newberry, another stratum of rock so widely distributed, and presenting as strongly marked lithological characters, as this. The pebbles are generally of quartz, and well rounded. The sand, which forms the paste, and holds together the pebbles of the conglomerate, is generally coarse, and consists of rounded grains of quartz, which differ from the pebbles only in size. In the anthracite region of Pennsylvania, conglomerate rocks sometimes occur between coal-beds, but in the other coal regions they are below all the workable coal-beds. Any cases of thin beds of good coal being found in or below the conglomerate, are exceptional and rare. It does not always maintain its character as a conglomerate, being sometimes an ordinary sandstone. The great lead mines of Joplin and Granby, in Missouri, are in a ferruginous sandstone, the equivalent of the Millstone Grit, or the Chester group, and the Hot Springs of Arkansas are in the Millstone Grit, greatly metamorphosed.

14 b. and c. Lower and Upper Coal Measures.—The series of rock-strata, among which the carboniferous coal-beds are found, are called the Coal Measures, which produce all the best coal of America. They consist of repeated alternations of exceedingly diversified rocks, of every degree of coarseness, from the smoothest fire-clay to exceedingly rough, silicious conglomerates, including within those extremes a wide variety of coal-shales, or mud-rocks, of almost every color and texture—marls, argillaceous sandstones and quartzose grits, also thin bands of limestones, both pure and magnesian, and numerous seams of carbonate of iron.

The numerous coal-beds themselves, which occur among this series of strata, the most interesting and important of them all, are also found in America in all their known varieties, from the most compact anthracite to the most fusible and bituminous kinds of coal. There is no invariable order for the strata of coal measures, but usually the bed of coal has a fire-clay bed below it, and shale immediately over it. Extending our view over a considerable district, we find these rocks are coarser and more massive towards the east or southeast; that they become more fine-grained, and less sandy and earthy, and the limestones increase in size and number as we proceed westward or northwestward; that many of the strata become reduced in thickness, and some of them entirely disappear. In Pennsylvania and Ohio the middle portion of the coal measures contains no coal seams, and hence is called the Barren Measures, thus dividing the formation into Upper and Lower Productive Coal Measures. The Lower Coal Measures sometimes contain valuable beds of iron ore. Salt is produced from the Lower Coal Measures in Western Pennsylvania, Virginia, Ohio, Indiana, Illinois and Kentucky.*

15. Permian.—In the annexed Guide a large number of stations in Kansas are given as being on the Permo-Carboniferous (Permian) series, and it was for a long time supposed that these rocks occur only in Kansas. Prof. C. A. White has recently assigned a large area in Texas to the Permian, and Prof. I. C. White is inclined to refer the Permo-Carboniferous beds of Southwestern Pennsylvania and West Virginia, the No. XVI. of Rodgers, to the same age, since they are the exact counter-part of the Texas rocks in their stratigraphical relations, lithology and palæontological affinities. The Permian rocks in Europe are limestones, sandstones, red, greenish, and gray marlites or shales, gypsum beds and conglomerates, among which the limestones, in some regions, predominate. In Kansas they consist, according to Prof. Mudge, of calcareous and arenaceous shales and beds of limestone. The latter are quite impure, but sometimes massive magnesian limestone, of a drab and buff color, is found, which furnishes an excellent building material. Prof. Swallow describes them as a series of limestones, marls, shales, sandstones, conglomerates and gypsums. The State capitol of Kansas, at Topeka, is built of Junction City limestone of the Permian formation. It is also used at Manhattan, and the buildings at Fort Riley are also conspicuous specimens of Permian limestone. The rocks here called Permian, are conformable to the coal measures, and contain many coal-measure fossils, with some not found below. Some geologists think there is no good reason for separating the Permian rocks from the Carboniferous system, of which they form the uppermost member (and in the Tables of Formations both Permian and Permo-Carboniferous are used.) Strata of the same age occur in Indiana, Texas and Mexico, where they contain many new and interesting reptilian remains. In most parts of the United States where the coal measures are not overlaid by the Permian beds, the latter have very probably been eroded. The Permian forms part of the New Red Sandstone of England, lying over the coal. The name is derived from *Permia*, a province in Russia.

* Having been for twenty-one years actively engaged in mining, transporting and selling coal, the author's business led him to the study of geology, particularly in its economic bearings, and he has given to the world all he knows about coal in another work entitled, "THE COAL REGIONS OF AMERICA: THEIR TOPOGRAPHY, GEOLOGY AND DEVELOPMENT," by James Macfarlane, Ph. D.

16-18. MESOZOIC.

16. Triassic.—As the railroads from Philadelphia to New York, the greatest lines of travel in this country, run on this formation, it is the most conspicuous and well known in the State of New Jersey, and one in which geologists are now taking great interest. Every observing person must have noticed it, and its aspect and composition are so uniform and well marked, that a description of it here will answer for the whole belt through the States of Pennsylvania, Maryland, Virginia, and North Carolina, from the Hudson River to Deep River, in the latter State, and in the Connecticut Valley.

The Triassic consists of dark reddish-brown sandstone, soft, crumbly brown shales, and the upper beds are coarse conglomerates. The almost invariable dip is towards the north-west, at angles ranging from 15° to 25°. Prof. H. D. Rogers thought this uniform dip was not caused by any uplifting agency, but that the rocks were originally laid down in this manner. His theory is that the formation owes its origin to an extensive ancient river, having its source at the eastern base of the Blue Ridge, in North Carolina. Following the remnants of the Triassic formation thence north-east, it gradually, from small beginnings, becomes larger, and has throughout a descending course. At the James River, it is four, at the Potomac six, at the Susquehanna twelve, and at the Delaware, thirty miles wide—the estuary being in the region of the Raritan and the Hudson. In New Jersey, therefore, this river was at its maximum.

The uniform dip was supposed by Prof. H. D. Rogers to be the result of the oblique or slanting mode in which the sediment has been laid down by a rapid and steady current washing the material from the south-east side or shore of the river. If it were due to an upheaval, this formation, measured in the usual way, would show an unheard-of thickness. In fact, it is very thin, as is shown in the exposures of limestone in the interior of the belt. All the appearances of the formation indicate, and there is much to sustain his opinion, that it never was tilted.

But more recent study of this interesting formation, has proven two facts: (1) that it was originally extensive, far beyond its present limits; and, (2) that, in at least its middle beds, the original deposits were horizontal, and have been since upturned. The two great belts of Triassic, which cross from Virginia into North Carolina, and one of them into South Carolina, not only have their rocks dipping in opposite directions, showing a long and broad uplifted country between Raleigh and Danville; but certain groups of coal-beds, which, though now dipping in contrary directions, must of course have been originally horizontal. Traces of coal-beds have been found in the Triassic of Pennsylvania, in York county, and at Phoenixville. The intermediate country in North Carolina was, therefore, presumably once covered with the formation, and probably all Virginia, east of the Blue Ridge, and all south-eastern Pennsylvania. The formation is seen passing under the plastic clays of New Jersey, and may extend far under the bed of the Atlantic, being thus connected with the beds of the Connecticut, and even those of the Bay of Fundy.—*Lesley*.

Relics of vegetation are occasionally found in the Triassic, in the form of highly compact and bituminous lignite, the longitudinal sections exhibiting the fibrous structure of the wood, whence it was formed. This lignite, occurring sometimes in seams of two or three inches in thickness, amid dark shales, has been a fertile source of delusion, some persons having been induced by the hope of finding valuable coal-mines, to waste much labor in the search. Although the Richmond and North Carolina coals are Triassic, all the geological facts discountenance the notion that it contains coal in New Jersey and Pennsylvania, the detached fragments of plants, which we meet with in the form of lignite, having evidently been loosely drifted into these sediments from the land. Prof. Emmons says there is nothing which can be regarded as equivalent to the coal measures of the Chatham (N. C.) and Richmond (Va.) series in the northern beds. All this formation was produced at a period subsequent to the great Carboniferous or coal-bearing rocks. There are great numbers of fossil fish in the Trias of New Jersey and Connecticut valleys, among them twenty species of *ganoids*; also the famous bird-tracks of Dr. Hitchcock. See notes 27 and 28 Massachusetts. Fossil plants are numerous in the Trias of Virginia and North Carolina.

When a large portion of the pebbles are of limestone, in the Triassic conglomerate, and the cementing red earth which unites them, contains an adequate quantity of the same material, the rock possesses the character of a marble, as on the Potomac River. The Portland stone, or reddish-brown sandstone, so much used for building purposes in New York and other eastern cities, is from the Triassic formation.

Extensive mines for copper ore have been wrought in the Triassic, in the State of New Jersey, the ore occurring in every case adjacent to igneous traps, but not in contact with them. All these mining operations have failed, on account of the ore being diffused or disseminated through the mass of the formation, and not being found compacted in regular veins. In Europe, the upper part of the Triassic is called Keuper, or copper.

Trap-Dikes.—Numerous parallel ridges and dikes of Trap, some of them many miles in length, and with the elevation of mountains 400 feet high, and ridges of all sizes, traverse the Triassic. Indeed, nearly all the trap-dikes are confined to this formation. The material which composes these rough, rocky ridges, undoubtedly protruded in a state of fusion, slowly and gently through long narrow fissures, produced by the gaping asunder of the rocks, and not by enormous violent disruptions, like those of volcanoes, as the strata through which they passed are very little disturbed, and the dip of the strata is very little affected by them. These trap-dikes have burst through the red shale and sandstone, after they were deposited, overflowing, while in a melted and highly heated condition, the adjacent beds, and greatly altering their texture, color and mineral aspect. The finest of these trap-dikes is the Palisades, on the west side of the Hudson River, above Jersey City, and extending north of that place. (See note 5, in chapter on New York). The tunnels and deep railroad-cuts through it, in Jersey City, afford good opportunities to observe the appearance of the stone, the principal constituents of which are hornblende, feldspar, and titaniferous oxide of iron. The little mountain of iron ore at Cornwall, in Lebanon county, Pennsylvania, was thrown up by a trap-dike of the Triassic.

That the trap is not confined, however, to the Triassic rock surface, is beautifully shown by the very numerous trap-dikes which cut the Highlands of Orange county, N. Y., and of New Jersey; by the long, straight, narrow dike which issues from the South Mountain, opposite Carlisle, in Pennsylvania, and cuts across all the formations, from the Potsdam up to the Subcarboniferous, at the mouth of the Juniata, (see notes 9, 77 and 170, in chapter on Pennsylvania), and especially by the still longer trap-dike recently discovered by Prof. Frazer, in Lancaster county, Pa., which not only penetrates the Welsh hills of gneiss, but cuts across the west end of the Chester county (Pa.) Valley, near the famous nickel mine, and reaches the Susquehanna River near the roofing slates quarries at Peach Bottom.—Lesley.

The Triassic formation yields the rock-salt and brine of the greater part of Europe, especially in England, Ireland, France, and part of Germany.

17. Jurassic.—The upper portion of what is commonly called the Triassic, on the Atlantic border, may belong to the Jurassic, and is so described by Prof. P. R. Uhler, in the annexed Guide for Maryland; and by Prof. W. B. Rogers, as Juro-Triassic and Juro-Cretaceous, in Virginia. But there are beds which are undoubtedly Jurassic in several of the eastern ridges of the Rocky Mountains, and other districts of the far West. The rocks are, in general, a gray or whitish marly or arenaceous limestone, with occasional pure compact limestone beds, intercalated with laminated marls. The enormous *Dinosauri*, recently obtained by Marsh and Cope from Colorado, are from the Jurassic. It is much less important here than in England, where it is subdivided into the Liassic, Oolitic and Wealden. The name is derived from Mount Jura, in Switzerland.

18. Cretaceous.—The Cretaceous formation, along the Atlantic Coast and the lower Mississippi Valley, consists of a series of beds of strata, differing from each other; but they are all earthy in form, consisting of beds of sand and sandy clay, except at a few points, where the strata have been cemented by oxide of iron into a kind of sandstone, or conglomerate. In Texas it contains extensive beds of gypsum. In New Jersey it produces the lower two beds of green-sand, called marl, which is extensively used in agriculture, the value of which is due to the potash and phosphates which it contains. Ninety per cent. of it is a green silicate of iron and potash, the rest being ordinary sand, and it contains no lime. But in Wyoming, Utah, and Colorado, the Cretaceous attains a thickness of 9,000 feet, and its rocks comprise beds of sand, marlite, clay, loosely aggregated shell-limestone, or rotten limestone, and compact limestone. At the middle of the Cretaceous, lie the beds of plastic-clay, outcropping across New Jersey, from Trenton to Amboy, and of great importance to the fire-brick and pottery factories, as described in the Report of Prof. Cook, of New Jersey, for 1876.

The name Cretaceous is from the Latin word for chalk, the chalk of England and Europe, being one of the rocks of this period; but in this country it contains no chalk, except in Western Kansas, 322 miles west of Kansas City, where a large bed exists. It is within one mile of Trego station on the Kansas Pacific Railroad, and is found over a tract 125 by 80 miles.

The Cretaceous formation, in the far West, passes upwards into a coal-bearing formation, several thousand feet thick, and covering on the upper Missouri River not less than 100,000 square miles in the United States, besides the portion of the belt extending into the British possessions. The area of other lignitic basins farther south, cannot be estimated, their width being unknown. Dr. Hayden

regards this coal-formation as transitional, or Lower Eocene 19. Tertiary, and in the within Guide for Colorado it is called the Lignitic Group, lying between the Cretaceous and Tertiary. Mr. Lesquereux is of the same opinion as to its Tertiary age, but nearly all other geologists regard it as Cretaceous.

In the annexed Guide for Wyoming and Utah, the formation is given at points where the coal is mined—Carbon, Separation, Black Buttes, Point of Rocks, Rock Springs, and Evanston. All the coal now mined in Wyoming is, according to the Guide, in the 18 d. Laramie Cretaceous, which corresponds with Hayden's Lignitic beds. Every division of the Cretaceous is said to be lignitic or coal-bearing, and may some day produce good coal. The Evanston beds are in the Laramie, but the Coalsville beds are probably in the 18 b. Colorado Cretaceous. The Rock Creek coal may be 18 c. Fox Hill.—A. Hague. There is no Carboniferous coal in the far west. The difference of opinion as to the age of the Lignitic or coal-bearing group, arises from the fact of its lying at the transition point from the Cretaceous to the Tertiary, where, as is not unusual, the fossils of both are mingled; and the controversy is as to precisely where the Cretaceous ends, and the Tertiary begins.

19-20. CENOZOIC.

19. Tertiary.—The Tertiary formation of the Atlantic coast is wholly of an earthy character, without solid rocks, consisting of sands and sandy blue clays, and above these yellow and brown ferruginous sand; also clays and sands imbedding extensive layers of uncemented fossil shells. But as we trace them south and southwest through the Southern cotton-growing states, it becomes more calcareous, consisting of lead-colored sandy clays, and whitish and bluish friable limestone in North and South Carolina and Eastern Georgia. West of that, the upper member consists of two limestone strata, the middle of sand and sandy marl, and the lower part of limestone and marl. H. D. Rogers suggests that on the Atlantic slope, opposite the Appalachian Mountains, the older rocks furnished only sandy and clayey sediments, and the Tertiary deposits composed of the ruins of the former, are of that character; while farther west a wide expanse of limestones fills the upper valley of the Mississippi, and hence the Tertiary deposits bordering the Gulf of Mexico, and extending up the Mississippi River, are of a greatly more calcareous or lime-bearing character. The cotton-growing lands of the Southern States are chiefly Tertiary. In the central part of the continent, the Tertiary beds are lake sediments, or fresh-water deposits; while on the west coast they are marine. The Tertiary, in the southern part of New Jersey, furnishes great quantities of bog iron-ore, but bog iron-ore is not peculiar to the Tertiary formation. The upper bed of the green-sand of New Jersey is Tertiary. In the far-west the Tertiary strata are in a greatly more indurated or rocky condition than those of the eastern coast. The 19 a. Eocene consists of beds of clay and sand, with round ferruginous concretions and numerous seams and local deposits of lignite, according to Mr. Lesquereux. Also gray and ash-colored sandstone, with more or less argillaceous layers. The 19 b. Miocene consists of white and light drab clays, with some beds of sandstone and local layers of limestone. The 19 c. Pliocene is composed of fine, loose sand, with some layers of limestone, and contains fossil bones of animals, which are scarcely distinguishable from living species.

20. Quaternary.—The materials of the glacial drift consist of vast accumulations of sand, pebbles, and boulders, belonging invariably to rocks lying northward of their present positions, with beds of boulder clay of great thickness, evidently brought from a great distance from the north, by causes quite different from any now in operation, and which nearly all geologists now believe to have been glaciers. This material is spread over the whole breadth of the North American continent, down to 38° or 40° of latitude, with glacial flood-deposits farther south along the valleys; and it is also spread, in the same way, over the northern part of Europe. Nearly every recently uncovered ledge of rock in the drift-covered region has its surface marked with the characteristic striae and furrows. These scratched, polished and grooved surfaces prove the former existence, according to Agassiz's theory, of an ice sheet, many thousand feet in thickness, moving across the continent over open level plains, as well as along enclosed valleys. When softer and harder rocks alternate, they are planed off to one outline or level, as if a rigid rasp had moved over the land, leveling all before it. On the contrary, on any surface where water flows, we find the softer materials have yielded first and been worn out, while the rocks will be left standing out, and show greater resistance. Glacial surfaces are highly polished, and are marked with scratches, grooves and deeper furrows. Sometimes the smooth surfaces are like polished marble, showing that the grinding material was held steadily down in firm, permanent contact with the rocky surface against which it moved, as is the case with the glacier. There are many deep ancient channels filled by the drift.

The usual characteristic marks of glaciers extend, according to Agassiz, over the whole surface of the east half of the continent, from the Atlantic shores to the States west of the Mississippi, and from the Arctic sea to the latitude of the Ohio, about the 40th degree of north latitude. The glacier marks trend from north to south, with occasional slight inclinations to the east or west, according to the minor irregularities of the surface. The ice of the great glacial period in America, is supposed to have moved over the continent as one continuous sheet, over-riding nearly all the inequalities of the surface. The drift is spread in one vast sheet over the whole land, consisting of an indiscriminate medley of clay, sand, gravels, pebbles, boulders of all dimensions, so uniformly mixed together, that in all parts of the country it presents a general similarity. The partial absence of stratification is one important characteristic of glacial drift. In the boulder clays there is no arrangement of the materials according to size or weight, whereas in water the lighter materials are carried farther than the heavier ones and deposited separately. In glacial drift there are large angular fragments by which it may be distinguished from alluvium, and it retains the mud gathered during the journey, spread through its mass, while the water-rolled deposits are washed clean, and consist usually of well-rounded pebbles, and there are no scratches on the exposed surfaces of the solid rocks.

The following general description of the limit of the drift is intended to show the approximate boundary between the glaciated and non-glaciated parts of the country. Although the margins of the different drift-sheets appear to form a single margin, because the sheets overlap, it must not be inferred that they are one and the same, or that they were formed at the same time, or neces-

sarily by the same agency. The majority of active and critical students of the drift of the interior now believe in two or more glacial epochs—not merely stages of retreat, but two or more independent ice incursions. Nor is it to be understood that the southern border is everywhere a moraine, in any special sense of the term. For more than half its extent across the country, there is no special aggregation of drift at the edge, and the precise method of its formation in certain portions is yet an open question.

In the northwestern corner of the United States, the margin of the great northern drift sheet unites or becomes confused with the local drift from the mountains, and it is impossible to say at present what is to be regarded as the margin of the great northern mantle. According to Dr. G. M. Dawson, there was a general southerly movement on the highlands of British Columbia. This appears to have penetrated to the basin of Puget Sound, but not to have reached the Columbia river. It seems also to have entered the northern edge of Washington Territory, near the northern elbow of the Columbia (Willis). It also penetrated into Idaho, as far as Lake Pend d'Oreille (Chamberlin), and also the northern border of Montana. Local mountainous glaciation was quite extensive along the Cascades, Sierra Nevada, Rocky Mountains and some minor ranges. East of the Rocky Mountains, the limit of northern drift enters the United States from Canada at the foot-hills of the mountains (G. M. Dawson), and running southward to the vicinity of Fort Shaw, curves eastward crossing the Missouri river about 40 miles above Fort Benton (Chamberlin and Salisbury). Thence it courses eastward, crossing the Yellowstone about 60 miles above its mouth, keeps north of the Northern Pacific railroad to within about 30 miles of Bismark (same authorities). Here it turns south, keeps in the vicinity of the Missouri river to Nebraska (Chamberlin, Todd), thence southerly to near the mouth of the Republican river (Todd, Mudge), thence easterly to the mouth of the Missouri river (Salisbury and Chamberlin). East of the Mississippi it forms a great loop, reaching nearly to the south end of Illinois (Worthen, Wright); swings north to the heart of Indiana (*ibid*) and south again into Kentucky (Sutton, Wright). Entering Ohio above Cincinnati it trends undulatingly northeast, and enters Pennsylvania a few miles above the mouth of the Beaver (Lewis and Wright); thence it extends northeastward into the State of New York, where, making a sharp curve, it again enters Pennsylvania in Potter county, and passes southeast to Belvidere, New Jersey (Lewis and Wright), and crosses that State with a northward arch to Perth Amboy (Cook and Smock). It traverses the whole length of Long Island (Cook, Smock, Upham) and appears on Block Island, Martha's Vineyard and Nantucket (Upham). The reader will understand that all south of the line described is unglaciated except local areas in the mountainous regions of the west, and possibly some in the Appalachians. From the Atlantic Coast to the Scioto valley, in Ohio, for the greater part, there is, on or near the margin, a well-marked terminal moraine, north of which lie other marginal moraines. From the Scioto valley westward, the margin of the drift is characterized by no sensible ridging of the nature of a terminal moraine, but terminates in a thin and often very attenuated edge. Eastward from the Atlantic shore, the edge of the glacial deposits is supposed to correspond with St. George's Bank and Sable Island Shoal, and to pass southeast of Newfoundland.

In Europe the border limit crosses the southeast corner of England, southern Holland, southern Germany, passing near Dresden, and thence onward south of Warsaw and Moscow, in a sinuous course, embracing the center of European Russia, and curving around to the northeast, runs northward to the Arctic Ocean, west of the Ural Mountains.

In no part of the United States are the phenomena of the drift displayed on a grander scale than in the Lake Superior region and on the northern borders of Wisconsin. Minnesota and Dakota are very deeply buried in drift. At the south side of Lake Superior, the drift is frequently 200 to 300 feet deep, and at the west end of that lake it is 300 or more feet thick, and it is 220 feet deep at Fargo, Dakota. The lower peninsula of Michigan is covered often from 200 to 300 feet deep.

To the southward the drift usually diminishes, and it becomes more evenly spread over the country. It is a singular fact that in the Galena lead region, at the corner of Illinois, Iowa, and Wisconsin, bounded by the Mississippi, Wisconsin, and Rock rivers, and in a considerable extent of territory north of it, no transported drift material can be found. The driftless region is 10,000 square miles in Wisconsin alone, or one fifth of the area of the State. Ohio has a very complete series of drift deposits, and they have been well studied and described by Dr. Newberry. He has classified the drift deposits as follows, in the ascending order: 1st. The Erie clay, a blue or gray unstratified boulder clay. 2d. The forest bed, consisting of a bed of soil, with timber, the remains of an ancient forest, found in Ohio, Indiana, etc., at various depths from the present surface. 3d. Lacustrine deposits, stratified sands and clays in northern Ohio; yellow clay abounding with gravel, in southern Ohio.

The Bluff formation along the Missouri and Mississippi rivers is a very peculiar and interesting one, resting upon the drift. It is of a slightly yellowish ash color, very fine, not sandy, and yet not adhesive. It makes an excellent soil, is easily excavated by the spade alone, and yet it remains so unchanged by the atmosphere and frost, that wells dug in it require to be walled only to a point above the water line, while the remainder stands so securely without support, that the spade marks remain upon it for many years. Road embankments and excavations upon the sides of roads stand like a wall. (See general note, Mississippi chapter and note on Vicksburg, Tennessee chapter.) The peculiar outline of the bluffs along the Missouri river is very interesting. They are often naked, entirely destitute of trees, and tower up from the river bottom-land, sometimes more than a hundred feet in height, and so steep in some places that a man cannot climb them, yet they are not supported by a framework of rocks, as other bluffs are, and not a rock or pebble of any size exists in them, except a few calcareous concretions where lime-water percolates through them. It is thought to be a lacustrine deposit, a shallow lake having, during the time of the Glacial epoch, occupied the whole of the basin of the Mississippi before the great rivers had cut their valleys down to their present depths (White). In Louisiana the bluff deposit contains three distinct groups of strata, the Port Hudson below, the Loess next, and the yellow loam above, and over this the alluvium and below them all the drift (E. W. Hilgard, F. V. Hopkins).

Earthy material brought together by the ordinary action of water is said to be alluvial, and the soil or land so formed is called alluvium or alluvion. Diluvium implies the extraordinary action of water. When the drift material covers the surface, of course it forms the soil, but in driftless regions the soil is an admixture of clay, sand, lime, etc., derived from the disintegration of the rocks beneath, with decomposed animal and vegetable substances. Where neither glacial nor alluvial action has taken place—as in some parts of our Southern States—the rocks are converted into a deep and strong soil, having undergone a process of decay which has rendered them so soft, sometimes to a depth of 20 or more feet, that they may be readily cut with a spade, although retaining all the veins and layers which mark their original stratification. Without having been broken or ground up, even the hardest rocks have quietly mouldered into a soft clayey mass, which, from its peculiar structure, has a natural drainage and possesses, moreover, great fertility.

The most important of geological formations is the last of all, the soil. On this thin, superficial, earthy covering of our planet depends all the growth of all vegetation, and on that depends all terrestrial animal life. But whether the material forming the soil remains unmoved in the same spot where it was once a solid rock, or is transported bodily by a glacier, or carried from the hills into the valleys by running water, and moved from place to place by larger streams and rivers, it was originally derived from the rock formations, therefore the agricultural as well as the mineral resources of the country depend on this geology.

This completes, in brief, the description of all that can be seen of the earth, classified in geological order, from the oldest of the rocks up to the sands which are now daily washed to our feet by the currents of the rivers and the waves of the sea.

REMARKS ON THE FOREGOING DESCRIPTIONS.

Paleontologists will be disappointed in this introduction, from which that is omitted which seems to them the most important, and gives the most interest and significance to the subject, namely: the life which they find in the formations, and which serves so important a purpose in their identification and classification. But another book would have been required for that purpose, and it would have been useless without a large number of expensive engravings.* Paleontology is the province of all the text-books on geology, to which this work is a supplement, not a substitute. Its only object is to teach local geology. The descriptions were an after-thought, and they should be regarded as an attempt—to present to the unlearned a first-lesson in geology, in the vernacular tongue, in the hope that it may help on the cause of popular science. They have swollen much beyond the original design, which was definitions, rather than descriptions; but they will serve to show that paleontology is not the whole of geology, and that the formations are more than a mere cabinet of fossils.

There are some things in the descriptions that are not accepted by all geologists. But the scope of the work did not permit any account of the conflicting opinions on disputed points, or discussions of the history of geological nomenclature and classification. Whether the Oriskany sandstone should be placed at the base of the Devonian, or at the top of the Silurian; whether Hudson River, Loraine, Nashville, or Cincinnati, is the best name for that formation; and whether Cambrian should include one, or all, or none of the Lower Silurian formations, and similar questions, seem of less importance to the ordinary reader, for whom the descriptions are intended, than to the professional geologist.

All kinds of geological tables are given, for, in accepting the valuable contributions of others on local geology, it was necessary to let them have their own way, in the chapters on their own States, in regard to the names and the arrangement of the formations. A common number, attached to them throughout the book, serves to identify the formations by whatever name they are called.

The valuable part of the book is the Geological Railway Guide, the design or plan of which is original with the author, as it is believed nothing of the kind has ever appeared, in any language. It is the work of many hands, and the hearty thanks of every lover of the science are due to all those who have contributed to its pages portions of the multitude of facts, forming this index to the geology of all important places in the United States and Canada. The reader will never know the amount of time, patience, labor, and care that it has cost.

* See "THE ANCIENT LIFE HISTORY OF THE EARTH," a comprehensive outline of the principles and leading facts of Paleontological Science. By H. A. Nicholson. Published by D. Appleton & Co., New York. 8vo., 407 pp. \$2.00. A very convenient and excellent manual of Paleontology only.

ARRANGEMENT OF THE GEOLOGICAL RAILWAY GUIDE AND DIRECTIONS FOR USING IT.

1. The railroads are arranged by states, and the states and territories are arranged in geographical order, with reference to the great lines of travel. But to find a railroad, the reader must depend on the index. Branches are placed after the main line, which is generally first given throughout without interruption.

2. When stations are omitted for the sake of brevity, which is seldom the case, the lists being uncommonly full, their geology will be understood to be the same as that given at the stations between which they occur. If the geology of two adjacent stations is different, it is evident enough that there is a transition from one to the other formation, between the stations, but the change is often so gradual that the transition point cannot be precisely given.

3. A few feet of difference in level sometimes carries the railway track to an upper or lower formation. Railroads, too, sometimes run across narrow, projecting tails, and scalloped points of a higher or lower formation, than that given in the Guide, but which it would occupy too much space to specify. Where too, the strata are disturbed and broken-up, all the formations cannot well be specified for want of room. In such cases the Guide serves only to show nearly where you are, the prevalent formation being given.

4. The hills, bluffs and higher ground in view, are often of a different formation from that given on the railroad, but not always higher in the series. Their elevation is often due to the hardness of the strata, the softer rocks forming the valleys, in which railways generally run.

5. Keep in mind the succession of the formations, as shown on the Guide, and whether you are going from older and lower to younger or higher strata, or *vice versa*. Notice the changes in the scenery with the changes in the formations.

6. When you come to a new formation, refer to the description of it, in the beginning of the book. But it is difficult to get a clear idea of the formations from even the best description. The reader must see them for himself, and these descriptions are intended to assist him in identifying them, and to impress their character and appearance upon his mind, or to recall them to his recollection after having seen them.

7. By a little close observation of the formations in traveling, you will find that most of them have peculiarities of their own, by which you can always know them, but which, like the features or appearances of persons, cannot be put into words, so that another who has not seen them could also recognize them. The form of the summits and slopes of the hills, and the general aspect of the country, but especially the rock-cuts on the railways, and other exposures of the formations, in quarries, and in the banks and beds of streams, should be closely observed; and if these are not visible, notice the stone used in buildings, and for the enclosures of fields, the character of the soil, and the fragments of stone mixed through its mass, which betray the nature of the solid rock formation beneath; observe also whether the rocks lie horizontally or in an inclined position.

The Dominion of Canada.⁵¹

By GEORGE M. DAWSON, D. S., F. G. S.,
Assistant Director of the Geological and Natural History Survey of Canada.

I. Maritime Provinces.

New Brunswick, Nova Scotia, and Prince Edward Island.

II. Quebec and Ontario.

III. Manitoba and North-West Territory.

IV. British Columbia.

V. Steamboat Routes.

1. The Dominion of Canada is, as a matter of convenience in this work, divided into four parts, and from a geological point of view such division is largely borne out by structural facts.

I. The Maritime Provinces includes Nova Scotia, New Brunswick, and Prince Edward Island.

II. Ontario and Quebec includes the provinces of the same names.

III. Manitoba and so much of the Northwest Territory as is traversed by railway-lines forms the third division.

IV. British Columbia, together with the eastern slopes of the Rocky Mountains (politically a part of the Northwest Territory) constitutes the fourth.

For each of these great divisions a separate table of formations is given.

For the purpose of enabling the traveler to provide himself with further information on geological points, the following notes on publications are attached:—Dominion of Canada generally: "Sketch of the Physical Geography and Geology of the Dominion of Canada," with map; Geological Survey, 1884. For economic minerals see also "Descriptive Catalogue of Exhibits at Philadelphia, 1876," and "Catalogue des Mineraux Roches, etc.," at the Exposition at Paris, 1878, by Dr. B. J. Harrington. Both published by the Geological Survey.

The "List of Publications of the Geological and Natural History Survey, 1884," enumerates all the official reports and maps to date.

I. MARITIME PROVINCES.—"Reports of Progress," Geological Survey. The whole of Cape Breton Island, part of the mainland of Nova Scotia, and nearly the whole of New Brunswick have been geologically mapped on contiguous sheets of uniform scale. Maritime Provinces generally: "Acadian Geology," Sir W. Dawson. (With supplement and map.) 1878.

The greater part of the really productive coal measures are included in the Province of Nova Scotia, the great spread of Carboniferous rocks in New Brunswick having so far been found to contain but thin, and, generally, scarcely workable, coal-seams. The deposits of the glacial period are often well shown in railway-cuttings, and extensive tracts are completely covered with these. The boulder-clay is the most persistent and universal. Peaty deposits underlying the boulder-clay have been observed locally; overlying the boulder-clay are stratified clays, sands, and gravels, and kames are frequent, particularly in New Brunswick. The stratified clays hold marine fossils in the vicinity of the coast of the southern and northern parts of New Brunswick.

The island of Cape Breton affords good coal, and a number of collieries are in operation. As it is not yet traversed by railway, it does not receive notice in the body of this work, but few places of equal area are of greater interest from a geological or picturesque point of view.

II. ONTARIO AND QUEBEC.—"Geology of Canada," Sir W. Logan. 1863. This work summarizes the main features to date, and is accompanied by an atlas of maps, sections, etc. Sir W. Logan's large map (25 miles to 1 inch, published 1866) includes, besides Ontario and Quebec, the Maritime Provinces and adjacent portions of the United States, and is much more detailed, for the region covered by it, than the map accompanying the sketch of 1884.

From 1863 reports in different portions of the provinces in annual "Reports of Progress." See also "Équisse Géologique du Canada," etc. 1867.

III. MANITOBA AND NORTHWEST TERRITORY.—In addition to the sketch of 1884, see reports and maps in annual "Reports of Progress" of Geological Survey, "Report on Geology and Resources of 49th Parallel," by Dr. G. M. Dawson.

Much information in the possession of the Geological Survey, but yet unpublished, is incorporated in the notes on these portions of the Dominion.

IV. BRITISH COLUMBIA.—In addition to the sketch of 1884, see annual "Reports of Progress," 1871, to date. A considerable portion of the province is covered by preliminary geological maps, on a scale of 8 miles to one inch.

The greater part of the facts for the Dominion of Canada are derived from the reports and maps of the Geological Survey. Dr. G. M. Dawson also wishes to acknowledge assistance received from Dr. Selwyn, the director of the Survey, and several members of the staff, especially Messrs. R. W. Ellis, R. Chalmers, and H. Fletcher. The notes on the Intercolonial Railway are chiefly due to Sir W. Dawson, as elsewhere mentioned.

I. Maritime Provinces.

Nova Scotia, New Brunswick, and Prince Edward Island.

List of Geological Formations.

Quaternary.	20 c. Saxicava Sand. 20 b. Leda Clay. 20 a. Boulder Clay or Till.	Silurian.	7. Lower Helderberg. Upper Arisalg Series. 5 c. Niagara. New Canadian Series. 5 b. Clinton. Lower Arisalg Series.
Triassic.	16. Upper Red Sandstone, and Traps of Bay of Fundy. Upper Red Sandstones of P. E. I.	Sil.-Camb.	4. Cobequid Series? 4. Graptolitic Shales of New Brunswick.
Carboniferous.	14 c. Upper Carb. and Permo-Carb. 14 b. Middle Carboniferous. 14 a. Millstone Grit. 13 a. Lower Carb. { Windsor Group. ²⁹ (Limestone Gypsum, etc.) } Horton Group. ³⁰ (Lower Coal Measures.) } Bonaventure formation (in N. E. New Brunswick & E. Quebec).	Cambrian.	2 c. Upper Cambrian. { Miré and St. Andrew Series, Cape Breton. 2 b. Middle Cambrian. Acadian Series. 2 a. Lower Cambrian. { Atlantic Coast Series, Nova Scotia.
Devonian.	12. Catskill. { Seaboard Beds (Bale des Chaleurs). 11. Chemung and Portage. { St. John Series. (Cordate Shale, Dadoxylon Sandstones.) } Gaspe Sandstones and equivalents on Bale des Chaleurs. 10. Hamilton. { 8. Oriskany, Nictau Series.	Huronian.	1 b. Felsitic, Chloritic, and Epidotic Rocks of St. John, Yarmouth, and Cape Breton, in part. 1 a. Gneiss, Quartzite and Limestone of St. John and St. Anne's Mountain, Cape Breton.
Ms.	Intercolonial Railway, N. S. ³	Ms.	Intercolonial Railway—Con.
0 Halifax. ³ 8 Bedford. 18 Windsor Jun. ⁴ 30 Elmsdale. ⁵ 39 Shubenacadie. 61 Truro. ⁶ 78 Londonderry. ⁷	2. Lower Cambrian. " " " " { Contact 2 Low. Camb. and 13 a. Low. Carb. 13 a. Lower Carbonif. 16. Triassic. 13 a. Lower Carbonif.	90 Wentworth. ⁸ 96 Greenville. 103 Thompson. 109 Oxford. ⁹ 111 River Philip. 122 Spring Hill Jn ¹⁰ 126 Athol.	5-7. Silurian. 13 a. Lower Carbonif. " " 14 a. Millstone Grit. " " " " 14 c. Upper Carbonif.

2. These notes are extracted, with little alteration, from a chapter by Sir W. Dawson, in "Hand-book for the Dominion of Canada." Published by Dawson Brothers, Montreal. 1894.

3. Halifax. Quartzites and slates of the coast series, or gold series, of Nova Scotia, believed to be of Lower Cambrian age. In the vicinity of Halifax and elsewhere it contains auriferous quartz mines. The nearest of these are situated at Montague and Waverly. The auriferous veins often also contain mispickel, and sometimes blend and other minerals. They run generally parallel to the strike of the enclosing rocks. The richly auriferous veins are seldom of great width, and the gold is sometimes disseminated also in the contiguous slate. The age of formation, of some at least, of the veins is subsequent to the Carboniferous, as auriferous conglomerates of Lower Carboniferous age with derived gold occur, and have actually been worked, at Gay's River. At Northwest Arm and other places may be seen granite, which traverses these beds as thick dikes or intrusive masses, and produces contact metamorphism. At Waverly Mine the obscure fossil named *Astropolithon* may be found in the quartzite.

4. Windsor Junction. Excellent exposures of the fossiliferous Lower Carboniferous limestones, and of the great beds of gypsum characteristic of that formation in Nova Scotia.

5. Elmsdale. Beyond Gay's River, the railway enters the Carboniferous country, and in some places quarries in the Lower Carboniferous limestone may be seen near the road.

6. Truro. At and beyond Truro, the railway traverses a portion of the Triassic red sandstones of Cobequid Bay. The sandstones may be seen in the cuttings, and the red color of the soil is characteristic. In approaching the Cobequid Hills, a more broken country, and beds of sandstone and conglomerate indicate the Carboniferous beds, which here reappear from under the red sandstone.

7. Londonderry. The road here enters a belt of highly-inclined slaty rocks of olive-gray and dark colors, which, at a little distance west of the railway-line, contain large and productive veins of iron

Intercolonial Railway—Con.		Ms.	Intercolonial Railway—Con.
Maccan. ¹¹	14 b. Middle Carbonif.	275	Beaver Brook.
Amherst, N.B. ¹²	14 c. Upper Carbonif.	286	Bartibogue.
Aulac.	{ 14 c. "	296	Red Pine.
		309	Bathurst. ¹⁶
Sackville.	14 c. Upper Carbonif.	321	Petite Roche. ¹⁷
Dorchester. ¹³	13 a. Lower Carbonif.	329	Belledune.
Memramcook.	"	388	Jacquet Riv'r. ¹⁸
Painsec Junc. ¹⁴	14 a. Millstone Grit.	347	New Mills.
Moncton. ¹⁵	"	353	Charlo.
Berry's Mills.	"	363	Dalhousie Jn. ¹⁹
Canaan.	"	372	Campbellton.
Coal Branch.	"	385	Metapedia. ²⁰
Weldford.	"	395	Mill Stream, Q.
Kent Junction.	"	405	Assametquag'n.
Rogersville.	"	420	Causapscal.
Barnaby River.	"	433	Amqui.
Chatham Junc.	"		
Newcastle.	"		

worked by the Steel Co. of Canada. This vein, or aggregation of veins, is primarily of carbonate iron and ankerite, with some specular iron, and has been changed in many places to a great depth of iron ore, which is the ore principally worked. Beyond this place the slates are seen to be pierced by intrusive masses of red syenite and by dikes of diorite and diabase.

Wentworth. The rocks mentioned above are here overlain by dark-colored shaly beds, hold-ossils of the age of the Clinton or older part of the Upper Silurian. The gray slates holding iron-ore are obviously of greater age, but how much greater is uncertain. For reasons stated in "Canadian Geology," they are regarded by Sir W. Dawson as Lower Silurian. Crossing the Cobequid, conglomerates are seen belonging to the southern edge of the Cumberland coal-field, on which no new enters.

Oxford. Contact of Lower Carboniferous and millstone grit.
Springhill. Brines from Carboniferous, utilized on small scale in manufacture of salt, 2½ miles from Springhill mines. A branch road leads to the mines of the same name, the most important coal-seams on this railway. Seven coal-seams, varying in thickness from two feet to thirteen feet six inches, are known in this district. The "black seam," eleven feet thick, is that which has been most extensively worked. The mines supply the coal used on the railway.

1. Maccan. Conveyance may be taken from here to the South Joggins, on the shore of Chebucto twelve miles distant. The section of the Carboniferous rocks on this part of the coast is one of the most instructive in existence, and has been rendered classic by the writings of Sir W. E. Logan, J. Lyell, and Sir W. Dawson. The section displays over 14,000 feet in vertical thickness of strata, dating from the marine limestones of the Lower Carboniferous to the top of the coal-measures, includes seventy coal-seams, of which, however, only two are of workable thickness. Besides numerous fossil plants (including erect sigillaria), the beds here yield reptilian remains and land-fishes.

2. Amherst. Near here fine examples of the alluvial deposits of the Bay of Fundy; more especially the great marshes of Amherst and Sackville.

3. Dorchester. Good sections of millstone grit formation. The contact between this formation and the Lower Carboniferous here. Copper-mine. Between Dorchester and Memramcook, salt-marsh.

4. Painsec Junction. On Shediac Branch, Carboniferous, chiefly or entirely millstone grit.

5. Moncton. From this point to near Bathurst the railway passes over the low Carboniferous of Northern New Brunswick, showing scarcely anything of the underlying rocks.

6. Bathurst. Beyond this point is the varied and interesting country of the Baie des Chaleurs, the Restigouche and Metapedia Rivers, of which it is possible only to note some of the more striking features. Three miles beyond Bathurst, line crosses dolerite intrusion 1 mile. A short distance north of station good sections of leda clay and saxicava sand, with fossils.

7. Petite Roche. From this station to Charlo, numerous massive intrusive bodies of dolerite cut through the Silurian rocks.

8. Jacquet River. The Lower Carboniferous here forms a narrow fringe along the shore. From station to Dalhousie, many good sections of leda clay and saxicava sand, with fossils.

9. Dalhousie. From Dalhousie the following localities may be visited: At Cape Bon Ami, near Dalhousie, a fine section of Upper Silurian shale and limestone, abounding in fossils, and alternating very thick beds of dark-colored dolerite. Apparently resting on these are beds of red porphyritic reccia, forming the base of the Devonian. On these, a little west of Campbellton, rest agglomerated shale, rich in remains of fishes (*Cephalaspis*, *Coccosteus*, etc.), and traversed by dikes of trap. Directly above these, conglomerates and hard shales, the latter full of remains of *Psilophyton* and *rostrigina*, and at a sandstone-quarry at the opposite side of the Restigouche, are similar plants, great silicified trunks of *Protolacites*. All these beds are Lower Erian or Devonian. At Scamegash, opposite Dalhousie, are magnificent cliffs of red conglomerate of the Lower Carboniferous, appearing from under these are gray sandstones and shales of Upper Erian age. These contain fossil fishes, especially of the genus *Pterichthys*, also fossil ferns.

10. Metapedia. The rocks exposed about here are principally slates and shales with marked slaty structure, of Upper Silurian age. Fine exposures in cuttings. Fossils occur in calcareous bands. Along Lake Metapedia, at the head of the river, the railway cuts through some limestone, probably of the Upper Silurian age, and then passes into Lower Silurian, and probably, in part, Cambrian, shales, sandstones, and conglomerates, of which the greater part are referred to the Quebec group. At the head of Metapedia River leda clay and saxicava sand, with fossils.

Intercolonial Railway—Con.			Intercolonial Railway—Con.		
Ms.			Ms.	St. John to Moncton.	
441	Cedar Hall.	5-7. Silurian.	0	St. John, N.B. ⁵⁵	2. Lower Cambrian.
448	Sayabec.	"	8	Coldbrook.	"
458	Tartague.	{ 2. Cambrian, and 4.	9	Rothsay.	1 a. Laurentian.
469	Little Metis. ²¹	Camb. Silurian.	17	Nauwigewauk.	13 a. Lower Carbonif.
477	St. Flavie.	"	22	Hampton.	"
485	St. Luce.	"	26	Passekeag.	"
495	Rimouski.	"	27	Bloomfield.	"
506	Bic. ²²	"	38	Norton.	"
515	St. Fabien.	"	39	Apoahqui.	"
525	St. Simon.	"	44	Sussex. ²³	"
534	Trois Pistoles.	"	51	Penobsquis.	"
544	Isle Verte.	"	60	Anagance.	14 a. Millstone Grit.
555	Cacouna.	"	66	Petitcodiac.	"
561	Rivière du Loup	"	76	Salisbury.	{ Contact 14 a. Millstone
567	Notre Dame.	"			Grit and 13 a. L. Carb.
573	St. Alexandre.	"	89	Moncton. ²⁴	14 a. Millstone Grit.
578	St. Andre.	"			
581	St. Helene.	"			
587	St. Pascal.	"			
591	St. P. de Ner.	"			
596	Rivière Ouelle.	"			
602	St. Anne.	"			
610	St. Roche.	"			
618	Elgin Road.	"			
617	St. Jean Port Joli	"			
622	Trois Saumons.	"			
625	L'Islet.	"			
629	L'Anse à Gile.	"			
632	Cap St. Ignace.	"			
639	St. Thomas.	"			
646	St. Pierre.	"			
649	St. François.	"			
653	St. Valier.	"			
657	St. Michel.	"			
663	St. Charles Jn.	"			
672	Harlaka.	"			
677	Levis.	"			
678	Point Levis ²³	"			
	(op. Quebec). ²⁴				

Picton Branch.		
61	Truro, N. S.	16. Triassic.
70	Union.	13 a. Lower Carbonif.
74	Riverdale. ²⁷	14 a. Millstone Grit.
80	West River.	5-7. Silurian.
89	Glengarry.	13 a. Lower Carb., etc.
96	Hopewell.	"
104	N. Glasgow. ²⁸	14 b. and c. Coal Meas.
112	Pictou Land'g.	14 c. Up. Coal Format'n.
113	Pictou.	"

Shediac Branch.		
179	Painsec Jn. N.B. ¹⁴	14. Carboniferous.
184	Dorchester Rd.	"
188	Shediac.	"
190	Pt. du Chêne.	"

Windsor and Annapolis Railway, N. S.		
0	Halifax. ³	2. Lower Cambrian.
13	Windsor Junc. ⁴	"
80		Intrusive Granite & 2 Lower Cambrian.

21. Little Metis. Cuttings in slates of the Quebec group. The River St. Lawrence, here thirty miles wide, suddenly breaks upon the view after passing Metis station. Beyond this point the line follows the strike of the Quebec group all the way to Point Levis, opposite Quebec.

22. Bic. Conglomerates here specially worthy of notice and well shown in cuttings.

23. Point Levis. In cuttings on a new connecting railway, about a mile from the station, beds holding *Graptolites*.

24. The rocks on which the city of Quebec stands are believed to be of Hudson River and Utica age, and fossils (*Graptolites*) lately obtained there confirm this view. The great Champlain and St. Lawrence fault cuts the north shore of the river west of Cape Rouge, and bending round, again cuts the shore immediately south of the city, and thence follows the channel of the river between Quebec and Point Levis. The falls of Montmorenci, near Quebec, are of great beauty, and show in the gorges Utica shale resting on Laurentian gneiss, which at the "natural steps" above the falls is overlain by Trenton limestone. Half way between the city and the falls, at a mill in the village of Beaufort, is a bank of boulder-clay overlain by fossiliferous sand and gravel (saxicava sand), rich in *Saxicava rugosa* and other shells. Clays with a somewhat richer fauna (upper leda clay) occur in the bank of a brook a little farther from the road to the north.

25. Sussex. Brines from the Lower Carboniferous, employed to a small extent for salt-manufacture.

26. Moncton. Between this station and Salisbury, in cuttings and gravel-pits, leda clays and saxicava sands.

27. Riverdale. The millstone grit series consists of sandstones and shales, often red, and conglomerate, associated with dark-colored beds holding fossil plants and *Natadites*, with a few underclays and thin seams of coal ("Acadian Geology").

28. New Glasgow. In this vicinity several important coal-mines. The productive coal area, so far as yet proved, is about nine miles long by three and a half wide, with an area of twenty-two square miles. Though thus limited in extent, the seams are extremely thick. The most important of these are

Windsor and Annapolis Railway— Ms. | Continued.		New Brunswick Railway—Con. Ms. | St. John to Vanceboro.	
39 Newpor.	13 a. Lower Carbonif.	80 Clarendon.	Granite.
45 Windsor. ²⁹	" (Windsor ser.)	88 Gaspereaux.	4. Cambro-Silurian.
47 Falmouth. ³⁰	" "	86 Enniskillen.	8-12. Devonian.
52 Hantsport.	" (Horton ser.)	38 Hoyt. ³⁷	{ 8-12. Devonian and 13 a. Low. Carbonif.
63 Wolfville. ³¹	{ 13 a. Lower Carb. and 5-7. Silurian.	42 South Branch.	14 a. Millstone Grit.
65 Port William.	16. Triassic.	46 Fredericton Jn.	"
70 Kentville. ³²	16. Triassic & 14. Carb.	49 Tracy.	"
82 Berwick.	"	61 Cork.	"
87 Aylesford.	"	66 Harvey.	13 a. Lower Carbonif.
98 Wilmot.	"	72 Prince William.	4. Cambro-Silurian.
101 Middleton.	"	76 Magaguadavic.	"
107 Lawrenceton.	"	85 McAdam.	"
115 Bridgetown. ³³	"	91 St. Croix.	"
121 Round Hill.	"	92 Vanceboro, Me.	"
129 Annapolis.	"	118 Danforth, "	1 b. Huronian,
New Brunswick Railway. (Formerly European and North American.) St. John to Vanceboro.		160 Lincoln, "	"
		188 Old Town, "	"
		206 Bangor, "	"
0 St. John. ⁴⁶	2. L. Camb. (Acadian.)	0 St. Andrews.	14 b. Middle Carbonif.
— Carleton. ³⁴	"	5 Chamcook. ⁴⁹	"
4 Fairville.	1 a. Laurentian.	15 Roix Road.	5-7. Silurian.
6 South Bay.	1 a. Lauren. limestones.	17 G. S. R'y Cross.	"
8 Sutton.	1 a. Laurentian.	20 Rolling Dam.	4. Cambro-Silurian.
11 Grand Bay.	{ 13 a. L. Carbonif. & Pre-Cambrian.	24 Dumbarton.	"
15 Westfield. ³⁵	1. Pre-Cambrian.	28 Watt Junc. ³⁸	"
20 Nerepis. ³⁶	{ 1. Pre-Cambrian and 13 a. L. Carbonif.	0 St. Stephens. ⁴⁴	Granite.
22 Eagle Rock.	Granite.	5 Maxwell.	4. Cambro-Silurian.
25 Wellsford.	"	8 Moore's Mills.	"
		15 Meadows.	"
		19 Watt Junc.	"

the "main seam" and "deep seam." The first has a thickness of thirty-eight feet six inches, and is capable of yielding at least twenty-four feet of coal of good quality. The "deep seam" (one hundred and sixty feet below) shows seven feet eight inches of good coal with three feet six inches of shaly coal. The coals are bituminous, and yield, as a rule, a good coke. A material known as "stellar coal," which is in reality an earthy bitumen, occurs near Stellartown, but is not at present worked. It is capable of yielding from 80 to 126 gallons per ton of oil, on distillation. The New Glasgow conglomerate seen at the road-bridge and elsewhere is a peculiar deposit locally developed in the Carboniferous, possibly nearly on the horizon of the coals. On the East River, above New Glasgow, important occurrences of iron-ore, limonite, specular iron-ore, and bedded hæmatite. These have not been worked.

29. Windsor. The Windsor series, or Lower Carboniferous limestone and gypsiferous beds, is a marine formation, holding characteristic shells and corals of the Lower Carboniferous period, and containing, in addition to the limestone, thick beds of sandstone, marl, and clay, usually red, and gypsum ("Acadian Geology").

30. Falmouth. The Horton series, or Lower Carboniferous coal measures, underlies the last, and consists of hard sandstones and shales, often calcareous, associated with conglomerate and grit, and in some places with highly-bituminous shales. It holds underclays and thin coaly seams, remains of plants, fishes, and entomostracans, and footprints of batrachians, but no strictly marine remains ("Acadian Geology").

31. Wolfville. From this point to Kentville the alluviums and marshes of the Bay of Fundy shores may be seen to the north.

32. Kentville. Though marked Triassic to Annapolis, the line of the railway runs throughout near the line of junction of this formation with Silurian, Devonian (Oriskany), and intrusive granites, which form the hills to the south. To the northward is visible the continuous ridge of the North Mountain, which intervenes between the Cornwallis and Annapolis Valley and Bay of Fundy shore. This is composed of Triassic traps, which overlie the red sandstones of the same formation. Cape Blomidon (near Wolfville) is the eastern extremity of the North Mountain. In this lofty cliff (four hundred feet) columnar basaltic trap is underlain by amygdaloid, containing numerous zeolitic minerals. The base is formed of red sandstone with gypsum veins. The cliffs bordering the coast from Cape Blomidon westward afford many zeolites in fine crystals.

33. Bridgetown. At Paradise, east of this station, fine crystals of smoky quartz derived from veins in granite.

34. Carleton. This town is, like St. John, on Lower Cambrian rocks, but the railway immediately enters an area of Pre-Cambrian, and turning round northward passes into Laurentian.

35. Westfield. Immediately beyond Westfield an outlier of Lower Carboniferous one mile wide. Pre-Cambrian rocks then extend to Nerepis, which is on (or near) a very small Lower Carboniferous outcrop.

36. Nerepis. Beyond this station Silurian $1\frac{1}{2}$ mile, followed by granite.

Ms. | New Brunswick Railway—Con.			Ms. | Between Gibson and Woodstock.		
28	Watt Junc. ³⁸	4. Cambro-Silurian.	0	Gibson.	14 b. Middle Carbonif.
29	Lawrence.	{ 4. Cam.-Silurian and 8-12. Devonian.	12	Keswick.	{ 4. Cambro-Silurian & 14 b. Middle Carbonif.
43	McAdam Junc. ³⁸		20	Zealand.	
49	Vanceboro, Me.	4. Cambro-Silurian.	28	Upper Keswick.	Granite.
59	Deer Lake.	Granite.	38	Millville.	4. Cambro-Silurian.
65	Canterbury.	4. Cambro-Silurian.	47	County Line.	"
75	Benton.	Syenite.	52	Woodstock Jn.	"
83	Debec. Junc.	5-7. Silurian.	57	Newberg Junc.	5-7. Silurian.
94	Woodstock.	4. Cambro-Silurian.	61	Up. Woodstock.	4. Cambro-Silurian.
83	Debec Junc.	5-7. Silurian.	63	Woodstock. ³⁹	"
86	Greenville.	"	Cumberland Railway.		
90	Houlton, Me.	"	0	Springhill Jn. ¹⁰	14 a. Millstone Grit.
94	Woodstock. ³⁹	4. Cambro-Silurian.	—	" Mines.	14 b. Middle Carbonif.
96	Up. W'dstock. ⁴⁰	"	—	Southampton.	14 a. Millstone Grit.
100	Newberg Junc.	5-7. Silurian.	—	Half-way Lake.	13 a. Lower Carbonif.
157	Gibson.	14 b. Middle Carbonif.	82	Parsboro.	"
107	Hartland.	5-7. Silurian.	Waterloo and Magog Railway.		
111	Peel.	"	Province of Quebec.		
117	Florenceville.	"	0	Magog. ⁴¹	5-7. Silurian.
120	Kent.	"	3	Castle Brook.	"
123	Bath.	"	5	Oxford L.	"
135	Kilborn.	"	7	Amber Brook.	1. Pre-Cambrian.
143	Perth.	"	9	Eastman.	"
143	Andover.	"	11	Dillonton.	"
149	Aroostook.	"	17	S. Stukely. ⁴²	"
156	Ft. Fairfield, Me.	"	23	Waterloo.	"
163	East Lyndon, "	"	Prince Edward Island Railway.⁴³		
168	Caribou, "	"	(198 miles in operation.)		
183	Presque Isle, "	"	Province—Prince Edward Island.		
149	Aroostook.	"	43 The whole of this island consists of Permo-		
167	Grand Falls.	"	Carboniferous and Triassic rocks, with general		
181	St. Leonard's.	"	red color, which has also been communicated to		
198	Green River.	"	the overlying drift and soil. The surface is rolling		
201	St. Basil.	"	and generally drift-covered, so that it has so far		
207	Edmundston.	"	been found impossible to separate the two for-		
			mations above mentioned except quite locally. The		
			remarkably interesting Triassic reptile <i>Bathygna-</i>		
			<i>thus borealis</i> was found in the excavation for a well		
			at New London. The soil of Prince Edward Island		
			is remarkably fertile and well cultivated.		

37. Hoyt. At junction Devonian and Lower Carboniferous.

38. Watt Junction to McAdam Junction. Kames and moraines frequent, and in some places cut through by the railway.

39. Woodstock to Grand Falls. Fine examples of terraces.

40. Upper Woodstock. A blast-furnace erected here, and hæmatite ores from Jacksonston at one time smelted. Bricks manufactured from drift-clays.

41. Magog. At northern or lower end of Lake Memphremagog, a very picturesque sheet of water, much frequented as a summer resort. Orford Mountain, a dioritic intrusion to the northeast.

42. South Stukely. Numerous occurrences of copper-ore in this vicinity. The Huntington copper-mine six miles distant. The ore is chiefly chloritic slate and diorite, impregnated with copper pyrites, pyrrhotite, and iron pyrites. Magnesite forms enormous beds in Bolton and neighboring townships, in association with serpentine, dolomite, etc. Chromic iron also found in serpentine. (Bolton, lot 4, range 2.)

44. St. Stephen, on New Brunswick Railway: thence granite $\frac{1}{2}$ mile, Cambro-Silurian $1\frac{1}{2}$ mile, granite 1 mile, Cambro-Silurian 16 miles to Watt Junction. On Grand Southern Railway: thence granite $\frac{1}{2}$ mile. Cambro-Silurian $\frac{1}{4}$ miles to Oak Bay, then Silurian.

45. Yarmouth. Highly altered rocks, consisting of chloritic and hornblendic slates, clay slates, quartz rock, etc.

46. Metegan. From this point onward the rocks differ in appearance from those previously met with, and though colored, provisionally, on the general map of the Geological Survey as Cambrian, may be Cambro-Silurian or Silurian.

47. Bloomfield. Exposures of fossiliferous Oriskany of Bear River and Clements near here.

48. Digby. Good exposures of Triassic red sandstones and trappean rocks at Digby Gut and St. Mary's Bay. Digby Gut forms the entrance to Annapolis Basin, and is passed through by steamers, connecting with railway, for St. John.

49. Chamcook. Thence Silurian 2 miles, granite $\frac{1}{4}$ miles, Silurian $1\frac{1}{2}$ miles.

50. Dyers. Cambro-Silurian 3 miles. Granite 8 miles. Near Dyers, kames may be observed.

Ms. | Western Counties Railway, N. S.		Ms. | Grand Southern Railway—Con.	
0 Yarmouth. ⁴⁶	2-4. Cambrian.	20 Dyer's. ⁵⁰	Granite.
5 Hebron.	"	29 Bonny River.	5-7. Silurian.
7 Ohio.	"	35 St. George. ⁵¹	1. Pre-Cambrian.
10 Greencove.	"	44 Pennfield. ⁵²	"
13 Brazil Lake.	"	54 New River.	"
16 Lake Jessie.	"	— Lepreaux. ⁵³	13 a. Lower Carbonif.
18 Norwood.	"	58 Lancaster. ⁵⁴	1 a. Laurentian.
21 Hectanooga.	"	67 Pr. of Wales.	"
30 Meteghan. ⁴⁶	4. Cambro-Silurian (?)	70 Spruce Lake.	"
33 Saulmerville.	"	74 Carleton.	2. Cambrian.
35 Little Brook.	"	82 St. John. ⁵⁵	"
37 Church Point.	"	Albert Railway, N. B.	
41 Belliveau.	"	0 Salisbury.	14 b. Middle Carbonif.
45 Weymouth.	5-7. Silurian (?)	4 Coverdale.	"
51 Port Gilbert.	"	10 Turtle Creek.	"
53 Plympton.	"	14 Baltimore.	"
56 North Range.	"	16 Dawson.	"
58 Bloomfield. ⁴⁷	"	17 Stony Creek.	"
63 Jordantown.	"	20 Salem.	13 a. Lower Carbonif.
67 Digby. ⁴⁸	16. Triassic.	22 Weldon. ⁵⁶	"
St. John.		24 Hillsboro. ⁵⁷	"
Halifax.		29 Albert Mines. ⁵⁸	"
Chatham Branch Railway, N. B.		31 Wilson.	"
0 Halifax. ³		38 Curryville. ⁵⁹	14 b. Middle Carbonif.
0 Chatham.	14 b. Middle Carbonif.	36 Cape.	"
9 Chatham Junc.	"	38 Daniels.	13 a. Lower Carbonif.
Point Levis.		40 Shepody. ⁶⁰	"
Grand Southern Railway, N. B.		42 The Hill.	"
0 St. Stephen. ⁴⁴	Granite.	44 Riverside.	"
5 Oak Bay.	4. Cambro-Silurian.	45 Albert.	"
14 St. Andrew's } Crossing. }	5-7. Silurian.	48 Harvey.	14 b. Middle Carbonif.

51. St. George. About three miles north of St. George, on the Magaguadavic River, a red syenite is extensively quarried. Water-power is employed to drive the polishing machinery. The stone much resembles Aberdeen "granite," and is of very fine quality and color.

52. Pennfield. Large, broad kame, or "whaleback."

53. Lepreaux. Anthracite of an impure character occurs in Devonian beds about four miles south of station. The anthracite is very impure, but is interesting, being the only known instance in America of a Devonian coal.

54. Lancaster. Between this point and next station (Prince of Wales) line passes nearly along junction of Laurentian (to north) and Devonian. At Lancaster, kames.

55. St. John. Few points are of greater geological interest than the vicinity of St. John, where within a radius of a few miles rocks occur which have been assigned to the Laurentian, Pre-Cambrian, Cambrian, Devonian, and Lower Carboniferous formations. The city stands on hard, slaty rocks of the Acadian group, which yield Primordial fossils, in some places in considerable abundance. The Devonian rocks are well exposed on the shores of Courtney Bay, and also in the vicinity of Carleton. About a mile west of the last-named place, on the shore, are the "fern ledges," which have yielded a great number of fossil plants, with some insects and crustaceans. The Devonian rests quite unconformably on the Cambrian series, and is again overlain unconformably by the conglomerates of the Lower Carboniferous.

56. Weldon. Between this point and Hillsboro the Petitcodiac salt-marsh.

57. Hillsboro. Gypsum quarries in the Lower Carboniferous rocks.

58. Albert Mines. The mineral known as Albertite, an inspissated bitumen filling veins in the black shales of the Lower Carboniferous, was at one time extensively worked here. The mines are now closed.

59. Curryville. Gray sandstone quarries.

60. Shepody. Thence to Harvey principally salt-marsh.

61. New Glasgow. (See note No. 28, under Intercolonial Railway.)

62. French River. Lower Carboniferous in valley, hills on both sides of Silurian rocks.

63. Marshy Hope. Opposite this point, on the coast, good exposures of fossiliferous Silurian rocks of Arisaig group.

64. Antigonish. Interesting display of Lower Carboniferous rocks, including beds of limestone and gypsum in this neighborhood.

65. Cape Porcupine. On the shore of the Strait of Canso, 500 feet in height. The central mass a red syenite, against which rest slaty beds, supposed by Sir W. Dawson to be Silurian. On these, conglomerates of the Lower Carboniferous.

66. Strait of Canso Wharf. Interesting exposures of Lower Carboniferous rocks at Plaster Cove and other places on north side of Strait of Canso.

Ms. | Eastern Extension Railway, N. S.			Ms. | Eastern Extension Railway—Con.		
0	New Glasgow. ⁶¹	14. Carboniferous.	51	Pomquet.	13 a. Lower Carbonif.
5	Glenfalloch.	"	53	Heatherton.	"
10	Merigomish.	"	56	Bayfield Road.	"
13	French River. ⁶²	"	57	Afton.	"
18	Piedmont.	5-7. Silur. or Cam.-Sil.	61	Tracadie.	"
22	Avondale.	"	62	Girrolais.	"
24	Barney's River.	"	66	Little Tracadie.	"
27	Marshy Hope. ⁶³	"	70	Harb. au Bouche	"
31	James River.	13 a. Lower Carbonif.	73	C. Porcupine. ⁶⁵	{ 13 a. Lower Carb. 5-7.
35	Brierly Brook.	"			{ Silurian and Syenite
41	Antigonish. ⁶⁴	"	79	Mulgrave.	13 a. Lower Carbonif.
46	South River.	"	80	S. of Canso,	
48	Taylor's Road.	"		Wh'f. ⁶⁶	"

II. Ontario and Quebec.

List of the Geological Formations in Quebec and Ontario.²²³

20. Quaternary, 20 d. Saxicava Sand.*	5-7. Silurian, 7. Lower Helderberg.
20 c. Leda Clay.†	" 6. Salina or Onondaga.
20 a. Boulder Clay or Till.	" 5 d. Quelph.
13. Lower Carbonif., 13 a. Bonaventure	" 5 c. Niagara.
8-12. Devonian, 12. Catskill (Ont.).‡	" 5 b. Clinton.
" 11. Chemung and Portage.§	" 5 a. Medina and Oneida.
" 10. Hamilton, including Marcellus and Genesee.	4. Siluro-Cambrian, 4 c. Hudson River
" 9. Corniferous or Upper Helderberg.	4 b. Utica.
" 8. Oriskany.	4 a. Trenton.
	3 c. Chazy.
	2-3. Cambrian, 3 b. Sillery and Levis.
	" 3 a. Calciferous.
	" 2 c. Upper and Lower Potsdam.
	" 2 b. Keweenaw.
	" 2 a. Animikie.
	1. Eozoic or Archaean, 1 c. Huronian.
	1 b. Norian or Labrador.
	1 a. Laurentian.

* In Central Ontario. 20 d. Algoma Sand and Artemisia Gravel.

† In Central Ontario. 20 c. Saugeen Clay; 20 b. Erie Clay.

‡ In Eastern Quebec. Scaumenac beds.

§ 8-12. Gaspé Sandstones, in eastern part of Quebec.

Grand Trunk Railway.			Grand Trunk Railway—Con.		
Ms. |	Portland to Montreal.	Alt.	Ms. |	Portland to Montreal.	Alt.
0	Portland, Me.	1 c. Huronian.	14		
5	Falmouth.	1 a. Laurentian.	51	86 Shelburne, N. H.	1 d. Montalban.
9	Cumberland.	"	85	91 Gorham.	"
11	Yarmouth.	"	86	98 Berlin Falls.	Lake Group.
27	Danville Junc.	1 d. Montalban.	203	122 Groveton Junc.	1 b. Huronian.
29	Lewiston Junc.	"	248	131 Breathes.	"
36	Mechanic's Falls	"	300	134 North Stratford.	"
47	South Paris.	1 a. Laurentian.	392	142 Wenlock, Vt.	"
70	Bethel.	"	654	149 Island Pond, Vt.	1 d. Montalban.
80	Gilead.	1 d. Montalban.	716	165 Boundary Line.	
				Geology in U. S. by Prof. Hitchcock.	

Grand Trunk Railway—Con.				Grand Trunk Railway—Con.			
Ms.	Lewiston Branch.		Alt.	Ms.	Montreal, Richmond, and Quebec. ¹⁰⁰		Alt.
29	Lewiston J., Me.	1 d. Montalban.	248	0	Point Levis ²³		
33	Taylor Brook.	"	205		(op. Quebec). ²⁴	2-3. Cambrian.	14
34	Auburn.	"	148	7	Chaudiere Curve	"	229
35	Lewiston, Me.	"	140	9	Chaudiere Junc.	"	
Portland to Montreal.				15	Craig's Road.	"	335
165	Norton Mills, } Quebec. ¹⁰⁰	Granite.		20	St. Agapit.	"	406
169	Dixville.	5-7. Silurian.	1187	28	Methot's Mills.	"	444
175	Coaticook.	"	1007	37	Lyster.	"	446
180	Richby.	"	819	41	St. Julie.	"	475
183	Compton.	"	734	49	Somerset.	"	442
186	Waterville.	"	646	55	Stanford.	"	128
198	Lennoxville. ¹⁰¹	1. Pre-Cambrian.	500	64	Arthabaska.	"	420
196	Sherbrooke. ¹⁰²	"	486	71	Warwick.	"	481
203	Brompton Falls.	5-7. Silurian.	471	794	Kingsey.	"	444
211	Windsor Mills.	"	420	84	Danville.	"	
221	Richmond. ¹⁰³	1. Pre-Cambrian.	391	98	Richmond.	1. Pre-Cambrian.	391
228	Lisgar.	"	529	137	St. Hyacinthe.	4 c. Hudson R.	111
231	Durham. ¹⁰⁴	2-3. Cambrian.	609	172	Montreal. ²¹⁰	{ 4 b. Utica (at Bona- venture Station). ⁵¹	
235	Danby.	"	438	Arthabaska and Three Rivers Branch.			
243	Acton Vale. ¹⁰⁵	"	312	0	Arthabaska.	2-3. Cambrian.	430
249	Upton.	"	204	4	{ Walker's Cut- ting.	"	
252	St. Liboire.	"		11	Bulstrode.	"	
255	Britannia Mills.	4 a. Trenton.	222	18	Aston.	"	
257	St. Rosalie.	4 c. Hudson River.		25	St. Celestin.	5 a. Medina and Oneida.	
262	St. Hyacinthe.	"	111	31	St. Gregoire.	4 c. Hudson R.	
269	St. Madeleine.	"	119	35	Three Rivers.	"	
275	St. Hilaire. ¹⁰⁶	"	86	Champlain Division.			
276	Belœil.	"	63	0	Montreal. ²¹⁰	{ 4 b. Utica (at Bona- venture Station).	
280	St. Brazile.	"		7	St. Lambert.	"	
282	St. Bruno.	"	98	12	Brosseau's.	"	
287	St. Hubert. ¹⁰⁷	"	91	20	Lacadie.	"	
290	St. Lambert.	4 b. Utica.	76				
297	Montreal. ²¹⁰	{ " (Bona- venture Station). ⁵¹					

100. The portion of the province included between the 45th parallel and Maine boundary and the St. Lawrence, generally designated the "Eastern Townships," has given rise to more discussion and difference of opinion between geologists than any other part of the Dominion. It is naturally a region of extreme geological complexity and disturbance, and can scarcely yet be considered as fully worked out. For a work like the present it is necessary, however, at least to denote the formations on one uniform system, whatever doubt may attach to the reference of some of them. For this purpose, Dr. Selwyn has kindly allowed the use of unpublished sheets, colored according to his views.

This district is the continuation northward of the Appalachian region. One of its most salient features is the great Champlain and St. Lawrence fault, which separates the undisturbed rocks of its northwestern from the plicated beds of its southeastern part. This great fracture runs from the head of Lake Champlain to Quebec and beyond. (See Note 5, New York.)

101. Lennoxville. The Hartford Mine, from which a great quantity of copper-ore has been extracted, is situated at a distance of five miles from this station. The ore is granular iron pyrites, mixed with copper pyrites.

102. Sherbrooke. Numerous occurrences of copper-ore in this vicinity and near Lennoxville. A bed of Jasper in the town of Sherbrooke.

103. Richmond. The Rockland and Melbourne slate quarries are within a few miles of this station. The slates here have been somewhat extensively worked, and are unsurpassed in quality. A few miles south of Richmond, in Melbourne, fine serpentine marbles occur.

104. Durham. The line between the Pre-Cambrian and Cambrian rocks is crossed at South Durham.

105. Acton Vale. A very productive mine of variegated and vitreous copper-ore, occurring in brecciated portions of a limestone-bed, was formerly worked here, but is now abandoned. Slate quarries also in this vicinity.

106. St. Hilaire. Belœil Mountain, one of the remarkable igneous protrusions which penetrate the flat-lying Silurian rocks of the St. Lawrence Valley, may be visited from this point. The mountain is partly composed of augite-syenite and partly of nepheline-syenite. An excellent summer hotel on the mountain. (See Note 210 on Mount Royal, Montreal.)

Grand Trunk Railway—			Ms. | Quebec and Lake St. John Railway.	
Ms. |	Champlain Division—Con.			
27 St. Johns. ¹⁰⁹	4 b. Utica.		0 Quebec. ²⁴	4 c. Hudson River.
38 Grande Ligne.	"		4 Junction.	"
39 Stottsville.	"		5 Little River.	"
44 Lacolle.	"		8 Andne Lorette.	"
50 Rouse's Pt., N.Y.	"		10 St. Ambrois.	1 a. Laurentian.
			14 Valcartier Sta.	"
			16 Jacques Cartier.	"
			17 St. Gabriel.	"
			23 St. Catharines.	"
			24 Lake St. Joseph	"
			27 Lake Sergeant	"
			30 Bourg Louis	"
			36 St. Raymond.	"
			39 Cotes Road.	"
			43 River Roudeau.	"
			46 Lake Simon.	"
			86 Lake Edward.	"
Montreal and Province Line.			North Shore Railway. ¹¹²	
0 Montreal. ²¹⁰	{ 4 b. Utica (at Bona- venture Station).		0 Quebec. ²⁴	
64 St. Lambert.	"		4 Lake St. John } 4 c. Hudson River.	
12 Brosseau's.	"		Railway Junc. }	
14 Laprairie.	"		7 Lorette.	"
20 St. Constant.	4 a. Trenton.		13 Belair.	"
28 St. Isidore Junc.	3 a. Calciferous.		25 Point Rouge.	4 a. Trenton.
27 St. Regis.	"		30 St. Bazile.	4 b. Utica.
38 St. Martine.	2 c. Potsdam.		34 Portneuf.	"
38 Howick.	"		38 Deschambault.	" or 4 a. Trenton.
44 Bryson's.	3 a. Calciferous.		42 Lachevrotiere.	4 a. Trenton.
47 Ormstown.	"		45 Grondines.	"
56 Huntingdon.	"		52 Ste. Anne le } 4 b. Utica.	
64 White's.	"		Perade. }	
74 Ft. Covington, N. Y.	"		57 Batiscan.	4 c. Hudson River.
30 St. Remi.	4 a. Trenton.		64 Champlain.	"
34 St. Michel.	"		74 Piles Branch Jn.	"
37 Hughe's.	3 a. Calciferous.		77 Three Rivers. ¹¹⁴	"
39 Johnson's.	"		85 Pointe du Lac.	"
44 Hemmingford.	"		92 Yamachiche.	"
47 Province Line.	"		97 Louiseville.	4 b. Utica.
50 Moore's J., N.Y.	2 c. Potsdam.		101 Maskinonge.	"
Central Vermont Railway.			107 St. Barthelemi.	"
Northern Division.			111 St. Cuthbert.	"
0 Montreal. ²¹⁰			115 Berthier Junc.	"
0 St. Johns. ¹⁰⁹	4 b. Utica.		123 Lanoraie.	4 c. Hudson R. or Utica.
7 Verselles.	"		129 La Valtrie.	4 b. Utica.
10 St. Brigede.	4 c. Hudson River.		132 L'Assomption.	"
14 W. Farnham.	4 a. Trenton.		136 L'Epiphanie.	"
21 Angeline.	2-3. Cambrian.		144 St. Henri Mas- } 4 a. Trenton.	
29 Granby.	"		couche. }	
37 W. Shefford. ¹¹⁰	"		148 Terrebonne. ¹¹⁶	"
43 Waterloo.	1. Pre-Cambrian.		154 St. Vincent de } "	
0 Montreal. ²¹⁰			Paul. }	
27 St. Johns. ¹⁰⁹	4 b. Utica.		159 St. Martin Jn.	3 c. Chazy.
36 St. Alexandre.	"		170 Hochelaga.	4 a. Trenton.
42 Des Rivières.	4 c. Hudson River.		171 Montreal. ²¹⁰	"
45 Stanbridge. ¹¹¹	"			
52 St. Armand. ¹¹²	2-3. Cambrian.			
57 Highgate Sp'gs.	3 b. Lewis Limestone.			
61 E. Swanton. [Vt.]	2 b. Potsdam Slate.			
64 Swanton Junc.	"			
70 St. Albans.	"			

107. St. Hubert. Extensive peat-bogs in this vicinity, from which a considerable quantity of peat was at one time extracted and manufactured.

108. Montreal, Richmond and Quebec. This road passes for the most part over an alluvial country, in general thickly drift covered, and little is seen of the underlying rocks, except in the neighborhood of Richmond. (See Note 106.)

109. St. Johns. Pottery-works. Rough earthen-ware articles are manufactured from clay underlying the town. The clay is marine (leda clay), twenty-two feet in thickness, and covered by one foot of soil.

North Shore Railway—Con.		Ms. | The Bay of Quinte Railway.
Ms. | Piles Branch.		Deseronto. 4 a. Trenton.
0 Three Rivers.	4 c. Hudson River.	East End. "
2 Piles Branch Jn.	"	Deseronto Junc. "
9 St. Maurice. ¹¹⁶	4 b. Utica & 4 a. Trenton.	Napanee. "
21 Lac a la Torgue.	1 a. Laurentian.	
29 Grand Piles. ¹¹⁷	"	
Berthier Branch.		Northern and Northwestern Railways.
Berthierville.	4 c. Hudson River.	0 Port Dover. ¹²⁴
Berthier Junc.	4 b. Utica.	9 Jarvis. " [kany.
Quebec Central Railway.		12 Garnett. "
0 Sherbrooke. ¹¹⁸	1. Pre-Cambrian.	14 Hagersville. "
4 Lenoxville.	"	16 Ballsville. 6. Onondaga.
10 Ascot.	"	24 Caledonia. "
19 Basin.	5-7. Silurian.	29 Glanford. 5 d. Guelph.
27 Dudsawell. ¹¹⁹	"	34 Rymal. "
36 Weedon.	"	40 Hamilton. ¹²⁵
47 Garthby. ¹²⁰	"	48 Burlingt'n B'ch. 5 a. Medina and Oneida.
57 Coleraine.	"	51 Burlington. "
67 Thetf'd Min's ¹²¹	1. Pre-Cambrian.	57 St. Ann's. 5 c. Niagara (?)
78 Broughton. ¹²²	"	59 Zimmerman. 5 a. Medina and Oneida.
91 St. Frederic.	"	66 Milton. "
100 Beauce.	"	75 Stewarton. "
105 St. Joseph. ¹²³	2-3. Cambrian.	77 Georgetown Jn. "
110 Scotts.	"	77 Georgetown. "
122 St. Anselme.	"	79 Glenwilliam. "
189 Levis.	"	81 Salmonville. "
		83 Cheltenham. "
		86 Riverdale. "
		93 Caledon East. "

110. Shefford. The railway here passes close to Shefford Mountain, an intrusive mass described as a granitoid trachyte. A larger mass of similar trachyte forms Brome Mountain to the south.

111. Stanbridge. Bog-iron-ore in considerable quantity in this vicinity. Formerly worked.

112. St. Armand. The limestone belt between this place and Phillipsburg affords several varieties of marble of different colors. Some of these have been quarried. A black marble occurring a mile and a half southeast of Phillipsburg is particularly worthy of note.

113. The line, for the greater part of its length, is at no great distance from the north bank of the St. Lawrence, and, owing to the depth of the drift deposits and alluvium, but little of the geological structure of the county can be seen. The outlines of the formations, as represented on the geological map of Canada, are somewhat uncertain for the same reason, and must at present be considered as approximations only.

114. Three Rivers. The railway here crosses the St. Maurice, a river important from a lumbering point of view, and having a total course of about three hundred miles. The Shawanagan Falls, on the St. Maurice, twenty-one miles distant, one hundred and sixty feet in height. The falls occur over Laurentian rocks, and are very picturesque. On the river below the falls the Potsdam sandstones may be observed to overlie the Laurentian. Extensive brick-yards at Three Rivers.

115. Terrebonne. Quarries. Chazy limestone. Stone taken to Montreal in scows, and has been extensively used in enlargement of Lachine Canal.

116. St. Maurice. Iron smelting, on a small scale, has been in operation here for one hundred and fifty years. The mineral employed is bog-iron-ore.

117. Grand Piles. Navigation by steamer on the St. Maurice from this point northward, into the heart of the Laurentian country.

118. Sherbrooke. (See Note 102 under Grand Trunk, Montreal to Portland.)

119. Dudsawell. About three miles northward, yellow and gray marbles capable of receiving a good polish, and highly ornamental.

120. Garthby. Deposit yielding native antimony, antimony glance, and other minerals, five miles from Garthby, in South Ham, lot 28, range 1. Lot 22, range (north) 1, Garthby; extensive deposit of iron and copper pyrites.

121. Thetford Mines. Asbestos extensively worked. The veins occur in association with serpentine rocks, which here characterize a considerable tract of country.

122. Broughton. The Harvey Hill Copper Mine, at one time extensively worked, but at present suspended, near here. Purple copper-ore, copper glance, and copper pyrites, occur in veins cutting the strata and beds conformable with the stratification.

123. St. Joseph. On the Chaudiere River. Gold occurs in placer deposits in numerous localities in this vicinity. These deposits have been worked to some extent, but are as yet imperfectly developed, as the auriferous alluviums are known to extend over an area of ten thousand square miles. The Kilgour nugget, found on the Gilbert River, weighed 5½ ounces. A handsome brecciated marble found on the Rivière Guillaume near here.

124. Port Dover. Corniferous limestones, with pores of corals frequently filled with petroleum. Eponites occur in limestones on the lake shore.

125. Hamilton. A band of sandstone known as the "gray band," and referable to the Medina formation, is quarried here and used in building.

Northern and Northwestern Railways—			Passumpsic Railway.		
Ms.	Continued.		Ms.	Quebec to Newport.	
96 Centreville.	4 c. Hudson River.		Quebec.		
99 Palgrave.	"		Montreal.		
105 Tottenham.	"		(S. E. R'y.)		
110 Beeton.	"		0 Sherbrooke. ¹⁰²	1. Pre-Cambrian.	
114 Thompsonville.	4 b. Utica.		3 Lenoxville.	"	
116 Alliston.	"		8 Capleton.	1. Pre-Camb. & 2-8. Sil.	
120 Everitt.	"		12 North Hatley.	"	
123 Tioga.	4 a. Trenton.		19 Massawippi.	5-7. Silurian.	
126 Lisle.	"		21 Ayer's Flats.	"	
129 Glencairn.	"		27 Libby Mills.	"	
151 Collingwood. ¹²⁶	"		30 Smith's Mills.	"	
135 Allandale.	"		34 Stanstead Jn. ¹²⁷	Granite.	
—Barrie.	"		40 Newport, Vt.	5-7. Silurian.	
Beeton and Barrie Branch.			South Eastern Railway.		
0 Beeton.			Main Line.—Montreal to Richford, Vt.		
—Beeton Junc.			0 Montreal. ²¹⁰		
9 Cookstown.	4 b. Utica.		0 Longueuil.	4 b. Utica.	
14 Thornton.	4 a. Trenton.		2 St. Lambert.	"	
19 Victoria.	"		12 Chambly Basin.	4 c. Hudson River.	
25 Allandale.	"		13 Chamb. Canton.	"	
—Barrie.	"		14 Richelieu.	"	
North Simcoe Branch.			19 Marieville.	"	
0 Allandale.	4 a. Trenton.		22 St. Angele.	"	
5 Colwell.	"		26 St. Brigide.	"	
13 Minesing.	"		32 Farnham.	4 a. Trenton.	
16 Hendrie.	"		37 Farndon.	2-3. Cambrian.	
19 Phelpsston.	"		39 Brigham.	"	
24 Elmvale.	"		42 East Farnham.	"	
26 Saurin.	"		45 Cowansville.	"	
30 Wyevale.	"		47 Sweetsburg.	"	
39 Penetang.	"		50 West Brome.	1. Pre-Cambrian.	
Allandale to Muskoka Wharf.			55 Sutton Junc.	"	
63 Allandale.	4 a. Trenton.		58 Sutton.	"	
64 Barrie.	"		63 Amhercorn.	"	
70 Gowan.	"		66 Richford, Vt.	1 b. Huronian.	
74 Oro.	"		Northern Division.		
78 Hawkstone.	"		0 Sorel.	4 c. Hudson River.	
87 Orillia.	"		6 St. Robert.	"	
90 Atherly.	"		10 Yamaska.	"	
95 Longford.	1 a. Laurentian.		14 St. David.	"	
100 Washago.	"		21 St. Guillaume.	"	
103 Severn.	"		27 Boulogne.	"	
109 Lethbridge.	"		32 St. Germain.	2-3. Cambrian.	
115 Gravenhurst.	"		36 Drummondville.	"	
116 Muskoka Wharf	"		45 Wickham.	"	
			54 Acton. ¹⁰⁵	"	

126. Collingwood. The Utica shales may here be observed to overlap the Trenton. These shales were at one time distilled here for oil.

127. Stanstead Junction. A considerable area of granite here, surrounded by dikes of the same material which penetrate the calcareous strata. The granite is excellent for building purposes.

128. Brome. About four miles southwest, iron-ores (specular schists) at one time worked. (See Note 110 on Brome Mountain, under Central Vermont Railway, Shefford.)

129. Sutton. Similar iron-slates to that above described in a number of places near here.

130. Abbotsford. Yamaska Mountain to the southeast, an intrusive mass about three miles in diameter, is for the most part a micaceous trachyte rock. The southeastern portion is, however, a diorite.

131. Rougemont. The intrusive mass forming the mountain of Rougemont is chiefly composed of olivine-diabase. This is one of a group of similar intrusions of which Mount Royal and Belair Mountain may be taken as typical.

South Eastern Railway— Northern Division—Con.			Grand Trunk Railway. Montreal to Toronto and Detroit.		
Ms.			Ms.		Alt.
60	Roxton Falls.	2-3. Cambrian.	0	Montreal. ²¹⁰	4 a. Trenton, 14 m. 51
67	South Roxton.	"	8	Lachine Jun.	"
71	Savage's Mills.	"	14	Pointe Claire. ¹³²	4 a. Black River. 109
77	Warden.	1. Pre-Cambrian.	21	Ste. Anne. ¹³³	2 b. Potsd. & Calcif. 124
80	Waterloo.	"	24	Vaudreuil. ¹³⁴	2 b. Potsdam, 12 m. 93
84	Foster.	"	31	St. Dominique.	"
88	Knowlton.	"	37	Coteau Land'g.	3 a. Calc. 3 c. Chazy. 161
92	Brome Cent. ¹²⁸	"	48	Bainsville.	3 c. Chazy, 33 miles.
96	Sutton Junc. ¹²⁹	"	54	Lancaster, Ont. ¹²⁸	3 a. Calciferous. 165
Champlain Division.			59	Summertown.	3 a. Calcif. & 3 c. Chazy.
0	Stanbridge.	2-3. Cambrian.	67	Cornwall.	3 a. Calciferous, 5 m. 155
2	Bedford.	"	72	Mille Roches. ¹³⁶	4 a. Trenton, 2 miles.
15	Mystic.	"	77	Dickinson.	3 c. Chazy, 30 miles. 243
14	Farnham.	4 a. Trenton.	81	Farran's Point.	"
20	L'Ange Gardien.	{ 4 a. Trenton and 4 c. Hudson River.	92	Morrisburg.	"
—	Papineau.	"	99	Iroquois.	3 c. Chazy. 243
26	Abbottsford. ¹³⁰	"	104	Edwardsburg.	3 a. Calciferous. 277
31	St. Pie.	"	112	Prescott Jun.	" 303
39	St. Hyacinthe.	4 c. Hudson River.	112	Prescott Jun.	3 a. Calciferous, 45 m. 303
41	St. Rosalie Jn.	"	164	Ottawa. ²¹⁶	3 c. Chazy, 7 miles.
48	St. Simon.	"	115	Gladstone.	3 a. Calciferous.
53	St. Hugues.	"	120	Maitland.	"
61	St. Guillaume.	"	125	BROCKVILLE. ¹³⁷	2 b. Potsdam. 281
St. Cesaire Branch.			129	Lyn. ¹³⁸	" 286
0	St. Cesaire.	4 c. Hudson River.	188	Mallorytown.	1 a. Laurentian. 326
4	Rougemont. ¹³¹	"	147	Landsdowne.	" 34 m. 324
8	Marieville.	"	155	Gananoque. ¹³⁹	" 361
St. Lambert to Longueil.			162	Ballantyne's.	" 361
0	St. Lambert.	4 b. Utica.	169	Rideau.	3 a. Calciferous. 303
2	G. T. Crossing.	"	172	KINGSTON. ¹⁴⁰	4 a. Black River. 274
6	Longueil.	"	180	Collins' Bay.	4 a. Trenton, 114 miles.
Central Ontario Railway.			194	Fredericksb'rg.	"
	Trenton Junc.	4 a. Trenton.	198	Napanee.	"
	Trenton.	"	213	Shannonville.	"
6	Carrying Place.	"	223	BELLEVILLE.	" 286
11	Consecon.	"	232	Trenton.	" 265
16	Hillier.	"	241	Brighton.	" 304
18	Four Corners.	"	249	Colborne.	" 323
21	Wellington.	"	256	Grafton.	"
25	Stinson's Creek.	"	264	COBourg.	" 297
28	Bloomfield.	"	270	PORT HOPE.	" 287
32	Picton.	"	279	Newtonville.	" 294
			286	Newcastle.	" 296
			290	Bowmanville. ¹⁴¹	4 b. Utica, 24 m. 263
			294	Saxony.	" 380
			299	Oshawa.	" 333

132. Pointe Claire. Black River limestones in quarry near station. Highly fossiliferous. Much of the stone for the piers of the Victoria Bridge was quarried here.

133. St. Anne. The west point of the island of Montreal is composed of Potsdam sandstone, which is seen in the immediate vicinity of the station. Just east of this a belt of calciferous occurs, and here yields some characteristic fossils. *Scolithus Canadensis* may be found in the Potsdam. The Potsdam forms an anticlinal, and underlies the county for about eight miles westward, when it is followed by a second belt of Calciferous. On the opposite side of Lac St. Louis, at Beauharnois, six miles from St. Anne, *Protichnites* in sandstone quarries.

134. Vaudreuil. In the seigniory of Vaudreuil bog-iron-ores occur in several places, particularly at Côte St. Charles.

135. Lancaster. From this point to Cornwall the railway nearly follows the line of junction of the Calciferous and Chazy formations.

136. Mille Roches. Quarries in Trenton limestone affording good building-stone. Some beds, when polished, resemble black marble.

137. Brockville. Cliffs on the river below Brockville show good sections of the Potsdam beds, and on the river, two and a half miles above that place, an outlyer of this formation occurs, the basal conglomerate of which may be seen resting on the Laurentian. In cutting of Brockville and Ottawa

Grand Trunk Railway—			Grand Trunk Railway—		
Ms. | Montreal to Toronto and Detroit—Con.			Ms. | Montreal to Toronto and Detroit—Con.		
303 Whitby.	4 b. Utica.	288	454 Alisa Craig.	10 b. Hamilt, 23 m.	774
310 Pickering.	"	287	461 Park Hill.	"	683
316 Port Union.	4 c. Hudson Riv, 44 m.	266	470 Widder. ¹⁴⁷	"	683
324 Scarboro Jun.	"	246	479 Forrest.	11b. Chemung, 91 m.	713
333 TORONTO.	"	254	496 Blackwell.	"	683
341 Weston.	"	426	501 SARNIA.	"	587
354 Brampton.	5 a. Medina, 11 m.	713	502 P. Huron, Mich.	"	683
363 GEORGETOWN.	"	847	512 Ch. & L. H. Jun.	"	683
365 Limehouse. ¹⁴³	5 c. Niagara.	1057	557 Milw. Junc.	"	594
368 Acton West. ¹⁴³	"	1159	561 Detroit Junc.	"	594
374 Rockwood. ¹⁴⁴	"	1183	564 DETROIT.	10 b. Hamilton, 3 m.	591
381 GUELPH. ¹⁴⁵	5 d. Guelph.	1068	Buffalo to Goderich and Detroit.		
386 Balmoral.	"	1085	0 BUFFALO.	9. Corniferous, 32 m.	583
391 Breslau.	"	1025	2 Fort Erie. ¹⁴⁶	"	
396 Berlin.	6. Onondaga, 14 m.	1101	19 Port Colborne.	"	
403 Doon.	5 a. Guelph.	880	32 Feeder.	6. Salina, 60 miles.	
408 Galt. ¹⁵⁹	"	1211	35 Dunnville.	"	
409 Petersburg.	6. Onondaga.	1211	59 Caledonia.	"	
405 Baden.	7 & 8. Corn. 16 m. & Oris.	1157	68 Onondaga.	"	788
421 STRATFORD.	" " [kany.	1157	76 BRANTFORD. ¹⁴⁸	"	
421 STRATFORD.	" " 33 m.	1190	84 Paris. ¹⁴⁹	"	
432 St. Mary's.	" " 1083		82 Drumbo.	9. Corniferous, 68 m.	1190
444 Thorndale.	" " 936		97 Bright.	"	
454 LONDON.	" " 815		115 STRATFORD.	"	
421 STRATFORD.	" " 26 m.	1190	128 Mitchell.	"	
432 St. Mary's.	" " 1083		139 Seaforth. ¹⁵⁰	"	
447 Lucan	" " 991		148 Clinton. ¹⁵¹	"	
			160 GODERICH. ¹⁵²	"	730

Railway, blue boulder-clay overlaid by brownish clay. An important deposit of iron pyrites in Elmsbethtown, near Brockville. Acid-works.

138. Lyn. Potsdam sandstone of good quality for building. A portion of the stone for the Parliament buildings at Ottawa was quarried here.

139. Gananoque. Quarry of red syenite on island opposite this place. The stone takes a good polish and is used for monuments, etc.

140. Kingston. Clays seen in railway cuttings near Kingston probably represent the *Saugeen* clays, a series overlying the Erie clays. These rest on a glaciated limestone surface. In one of the cuttings Silurian beds, conglomeritic, etc., and possibly Calciferous in age, are seen resting on Laurentian gneiss. The Trenton (?) here affords good building-stone. Kingston is familiarly known as "The Limestone City." A considerable quantity of apatite is brought out here from points in the vicinity of the Rideau Canal.

141. Bowmanville. Quarry in upper part of Trenton limestone.

142. Limehouse. Materials derived from the Clinton formation employed in manufacture of mineral pigments.

143. Acton West. Artemisia gravels thirty miles.

144. Rockwood. Considerable display of upper part of Niagara limestone in this vicinity. From Rockwood the slope of the country westward is at about the same rate with the dip of the beds, so that on arriving at Guelph we should be nearly on the same horizon as at the first-mentioned locality.

145. Guelph. Quarries in the Guelph formation yielding building-stone (dolomite) of a superior character. Casts of fossils.

146. The portion of this province lying between the Great Lakes, and generally designated the "Ontario Peninsula," is geologically an extension of the rock-series of the adjacent portion of the State of New York, its formations showing throughout a close correspondence to those of that State. The separation marked by the lakes and Niagara River is to be regarded rather as accidental than structural. The greater part of the surface of this portion of the province is heavily covered by deposits due to the glacial period, of which local details sufficiently precise for mention in connection with the actual lines of railways are frequently wanting.

These superficial deposits only are often seen for considerable distances along the railways.

The boulder-clay, which is thick and almost universal, is overlaid by stratified clays (Erie clays), which have not been found to hold marine fossils. The clays with marine shells, which occur in the eastern extremity of Ontario and in the Ottawa Valley, are an extension of those of the Province of Quebec, elsewhere described.

The Saugeen clays have been distinguished as an upper portion of the Erie clays, and are locally unconformable on them. They are brownish and calcareous, with beds of sand. North of Lake Huron, and between Georgian Bay and the Ottawa River, the clays are overlain by the Algoma sands, of which the Artemisia gravels, covering a considerable area in the Ontario Peninsula, are possibly a local development.

147. Widder. Near the station a cutting shows forty feet of the Hamilton formation. The rocks

Canada Southern Railway.			Grand Trunk Railway.		
	Alt.		Ms. | Great Western Division.	Alt.	
FFALO.	573	9. Corniferous, 2 m.	SUSP. BRIDGE.	547	
storia. ¹⁴⁶	607	6. Onondaga, 58 m.	0 Clifton. ¹⁵⁵	5 c. Niagara, 9 m.	
agara Junc.	608	"	9 Thorold. ¹⁶⁹	"	
lland.	589	"	11 St. Cath'rines ¹⁶⁸	5 a. Medina, 34 m.	397
rry.	590	"	27 Grimsby. ¹⁵⁶	"	287
NFIELD.	621	"	43 HAMILTON.	"	255
an's.	637	"	43 HAMILTON.	5 a. Medina, 32 m.	253
gersville.	740	9. Corniferous, 64 m.	45 Toronto Junc.	"	305
la Nova.	732	"	56 Bronte.	"	
ndham.	817	"	69 Port Credit.	4 c. Hud. Riv., 7 miles.	
sonburg. ¹⁶⁶	806	"	75 Mimico.	"	
ringfield.	796	"	82 TORONTO.	"	
THOMAS.	766	10. Hamilton, 74 m.	43 HAMILTON.	5 b. Clinton.	255
CLAIRE JN.	765	"	49 Dundas. ¹⁵⁷	5 c. Niagara.	517
ia.	745	"	55 Copetown. ¹⁶⁸	5 b. Clinton.	749
marck.	711	"	59 Lynden.	5 d. Guelph.	751
ghgate.	739	"	62 HARRISBURG.	"	734
xton.	602	"	65 St. George.	6. Onondaga.	
bury.	592	"	67 Dumfries.	" Grav. ridge.	842
mber.	604	9. Corniferous, 48 m.	72 PARIS.	"	932
odalee.	619	"	79 Princeton.	9. Corniferous.	967
lchester.	611	"	84 Governor's.	"	957
HERSTBURG.	600	"	91 Woodstock.	"	852
osse Isle.		"	110 Dorchester.	"	806
nton.		"	119 LONDON.	10 b. Hamilton, 26 m.	811
TROIT.	580	10. Hamilton, 10 m.	129 Komoka.	"	752
ffalo.	573	9. Corniferous.	140 Longwood.	11 b. Chemung, 23 m.	743
agara Junc.	608	6. Onondaga.	145 Appin.	"	709
ick Creek.	568	5 d. Guelph.	156 Newbury.	10 b. Hamilton, 25 m.	623
ippewa. ¹⁵⁴		5 c. Niagara.	168 Thamesville.	"	596
fton. ¹⁵⁵		"	188 Chatham.	9. Corniferous, 36 m.	595
sp. Bridge ¹⁴⁶	547	"	198 Prairie.		
eenston.		5 a. Medina.			
agara.		"			

marly clays with thin limestone beds, and are highly fossiliferous, yielding *Spirigera mucro-*
trypa reticularia, *Spirigera concentrica*, etc.

Brantford. Erie clay used in manufacture of white brick. Artemisia gravels twenty miles.
Paris. Gypsum quarried in a number of places in this vicinity. Two beds, each four or five
thickness, separated by four feet of shale.

Seaforth. Salt-works. Brines from the Onondaga formation employed.

Clinton. Salt found in boring at 1,180 feet.

Goderich. In cliffs on the Maitland River, near Goderich, sections of Corniferous formation
tones and limestones—in some places fossiliferous. In 1865 brine was discovered at Goderich,
ing made with the hope of obtaining petroleum. In the next three years several wells were
re and in the vicinity the salt being derived from the Onondaga formation. In 1867 Mr. Att-
ted a boring of 1,517 feet, for the purpose of ascertaining the amount and character of the rock-
had been reached in some of the wells made before that date. This boring showed a total
ss of 126 feet of rock-salt in 520 feet of strata. Dr. Hunt conducted analyses of the specimens
and proved that some of the beds are extremely pure. He calculates at 850,000 bushels to
the yield of salt from the best white layer of ten and a half feet in thickness. The area under-
these salt deposits does not extend as far north as Teeswater, but appears to have a consider-
ension southward. Owing to difficulties met with in sinking a shaft to the rock-salt, the beds
t yet been worked, though a large quantity of excellent salt—particularly suitable for dairy
manufactured from the brines.

Brantford. (See Note 148 under Buffalo to G. and D.) Artemisia gravels thirty-five miles.
Chippewa. Base of Onondaga probably in this vicinity, but whole country covered by clays.
Clifton. In the slope and precipice over which the Niagara Falls occur, the whole thickness
Niagara formation is included. On Goat Island fresh-water sands are found overlying the
clay, and on the Canadian side sixteen species of fresh-water and land shells have been found
ar sands. (See Notes 89 and 42 in New York.)

Grimsby. Quarries in Niagara limestone and sandstone.

Dundas. Close to station, on north side, a fine section of Niagara and Clinton. Quarries. Great
ss of Quaternary clays in this vicinity. North of the town a gravelly ridge or shore deposit 318
ve the lake. Brick-yards.

Copetown. Summit of Niagara escarpment.

Galt. Good exposures of Guelph formation with fossils. Quarries yielding magnesian lime-
suitable for building.

Preston. Good sections of Guelph formation. Fossils.

Grand Trunk Railway— Ms. | Great Western Division— <i>Con.</i>			Ms. | International Railway.	
207 St. Clair.	9. Corniferous.		0 Sherbrooke. ¹⁰²	1. Pre-Cambrian.
221 Tecumseh.	"	590	Lennoxville.	"
229 WINDSOR.	"	582	Johnville.	5-7. Silurian.
230 DETROIT.	10 b. Hamilton, 1 m.		Bulwer.	"
Great Western Railway Air Line.			Birchton.	"
0 Buffalo.	9. Corniferous, 75 m.		Cookshire.	"
16 Welland. ¹⁴⁶	"		Robinson.	"
72 Simcoe.	"		Gould.	"
81 Delhi.	(See Loop Line, on		Scotstown.	"
99 Corinth.	page 67.)		McLeod's Cross.	"
102 New Sarum.			Marsden.	"
117 St. Thomas.			Springhill.	"
136 Baird's.			Sandy Bay.	"
130 Lawrence.			69 Lake Megantic.	"
145 GLENCOE.	11b. Chemung, 2 m.		Grand Trunk Railway.	
224 Windsor.			Georgian Bay and Lake Erie Division.	
225 Detroit.			0 Warton.	5 c. Niagara, 4 m.
Northern Railway of Canada.			8 Hepworth.	5 d. Guelph, 20 m.
0 TORONTO.	4 c. Hud. Riv., 24 m.	847	15 Allenford.	"
14 Thornhill.	"	633	20 Tara.	"
18 Richmond Hill.	"	847	33 Chesley.	6. Onondaga.
22 King.	"	955	36 Elmwood.	"
30 Aurora.	4 b. Utica, 14 m.		44 Hanover.	" Artem. gr'n
34 Newmarket.	"	772	50 Neustadt.	"
38 Holland.	"	743	64 Harriston.	"
49 Gifford.	5 d. Guelph, 34 m.	753	69 Palmerston.	"
52 Lefroy.	"	779	0 Palmerston.	6. Onondaga.
57 Bramley.	"	888	11 Mount Forrest.	5 c. Guelph.
63 Allandale.	"	738	17 Holstein.	"
74 Angus.	4 b. Utica.	627	22 Varney.	"
86 Stayner.	"	717	26 Durham.	"
94 COLLINGWOOD.	"	690	69 Palmerston.	6. Onondaga.
105 Meaford.	4 c. Hud. Riv., 16m.	674	78 Listowell.	9. Cornif. & 8. Oriska
Kingston and Pembroke Railway.			88 Millbank.	"
0 Mississippi.	1 a. Laurentian.		91 Milverton.	"
10 Oso.	"		104 Stratford Junc.	"
14 Sharbot Lake.	"		105 Stratford.	"
18 Olden.	"		112 Travistock Jn.	"
22 Parham.	"		113 Travistock.	"
29 Hinchinbrooke.	"		127 Woodstock.	"
31 Bedford.	"		136 Burgessville.	"
35 Verona.	"		141 Brantford Junc.	"
39 Hartington.	Birdseye & Black River.		144 Otterville.	"
42 Harrowsmith.	4 a. Trenton.		149 Can. So. Junc.	"
47 Murvale.	"		160 Simcoe.	"
51 Glenvale.	"		167 Port Dover.	"
59 G. T. Junction.	Birdseye & Black River.		Wellington, Grey, and Bruce (G. W. Div.).	
61 Kingston.	"		Brantford. ¹⁶³	
Cobourg, Peterborough, and Marmora Ry.			0 Harrisburg.	5 d. Guelph.
Cobourg.	4 a. Trenton.		6 Branchton.	"
Baltimore.	"		12 Galt. ¹⁶⁹	"
Summit.	"		16 Preston. ¹⁶⁰	"
Harwood.	"		19 Hespeler.	"
			27 Guelph.	" 1
			40 Elora. ¹⁶¹	" 1
			43 Fergus.	" 1
			49 Alma.	"

Grand Trunk Railway— Wellington, Grey, and Bruce (G. W. Div.)— Ms. | Continued.				Ms. | Great Western Division.—Loop Line.	
55 Goldstone.	6. Onondaga.	1461		16 Buffalo.	9. Corniferous.
58 Drayton.	"	1394		23 Black Rock.	"
62 Moorefield.	"	1351		31 Fort Erie.	"
70 Palmerston.	"	1314		33 Welland Junc.	6. Onondaga. 577
75 Harriston.	"	1264		40 Marshville.	"
82 Clifford.	"	1234		48 Moulton.	"
91 Mildmay.	"	1030		53 Diltz.	"
97 Walkerton. ¹⁶²	"	933		61 Canfield Junc.	" 616
101 Dunkeld.	"			67 Cayuga. ¹⁶⁵	"
104 Cargill.	"			72 Nelles' Corners.	9. Cornif. & 8. Orisk. 715
105 Pinkerton.	"	861		76 Jarvis.	" 701
112 Paisley.	"	776		81 Renton.	"
118 Turners.	"			88 Simcoe.	" 719
125 Port Elgin.	"	675		92 Nixon.	"
129 Southampton.	"	616		81 Delhi.	" 795
				88 Courtland.	" 776
0 Palmerston.		1314		92 Tilsonburg. ¹⁶⁶	" 785
5 Gowanstown.	9. Cornif. & 8. Orisk.	1285		94 Tilsonburg Jn.	"
9 Listowel.	"	1263		99 Corinth.	" 767
16 Atwood.	"	1204		107 Aylmer.	10. Hamilton. 781
19 Henfryn.	"	1166		102 New Sarum.	"
22 Ethel.	"	1174		117 St. Thomas.	" 767
27 Brussels.	"	1123		122 Payne's.	"
34 Blue Vale.	"	1079		126 Baird's.	"
Wingham Junc.	"			129 Lawrence.	" 742
38 Wingham.	"	1082		134 Middlemiss.	"
44 White Church.	"	1046		139 Ekfrid.	"
50 Lucknow.	"	910		145 Glencoe.	11. Chem. & Portage. 728
53 Ripley.	"	807			
66 Kincardine. ¹⁶³	6. Onondaga.	590			
Sarnia Branch (G. W. Div.).				London, Huron, and Bruce Division.	
0 London.	10. Hamilton.	806		0 London.	9. Cornif. & 8. Oriskany.
10 Komoka.	"	822		4 Hyde Park Jn.	10. Hamilton.
20 Strathroy.	"	747		8 Ettrick.	9. Cornif. & 8. Oriskany.
26 Kerwood.	"			11 Ilderton.	"
33 Watford.	11. Chemung & Port. ⁷⁸⁷			16 Brecon.	"
42 Wanstead.	"	702		20 Clandeboye.	"
45 Wyoming.	"	712		26 Centralia.	"
51 Petrolia. ¹⁶⁴	"			31 Exeter.	"
51 Mandaumin.	"	647		37 Hensall.	"
61 Sarnia.	"	589		39 Kippen.	"
— Point Edward.	"			43 Brucefield.	"
— Port Huron, Mich.	"			50 Clinton.	"
				57 Londesborough.	"
				61 Blyth.	"
				67 Belgrave.	"
				73 Wingham Junc.	"
				74 Wingham.	"

161. Elora. Good sections of Guelph formation in cliffs seventy-five to eighty feet high.

162. Walkerton. Good exposure of Erie and Saugeen clays at bend of river, on 28th lot of first range north of Durham road. The Saugeen clays are deposits locally developed and overlying the Erie clay.

163. Kincardine. White and yellow bricks manufactured from drift clays.

164. Petrolia. The best petroleum wells of Ontario are in this vicinity. Surface oil had been known to exist for many years, but was first obtained by boring in 1860. The oil-producing region round Petrolia has an area of about eleven square miles. The surface is level, and consists of a bluish clay to a depth of about one hundred feet. Below this the borings penetrate about three hundred and eighty feet of dolomites, shales, and marls, to the most productive stratum, which is reached at a depth of four hundred and eighty feet. The borings at first produced flowing wells, but pumping is now necessary. Most of the oil is refined in London, Ont. It is supposed to originate in the Corniferous formation.

165. Cayuga. Extensive gypsum deposits about three miles from the town. The bed worked is about five feet in thickness.

166. Tilsonburg. Petroleum has been obtained in this vicinity.

167. Brantford. Erie clay used in manufacture of white brick. Artemisia gravel thirty-five miles

Great Western Division.			Grand Trunk Railway—		
Ms.	Brantford, Norfolk and Port Burwell R'y.		Ms.	Midland Division—Con.	
	Harrisburg.	734	17	Millikens.	4 c. Hudson River. 681
0	Brantford. ¹⁶⁷	659	20	Unionville.	" 577
5	Mt. Pleasant.	810	23	Markham.	" 640
7	Mt. Vernon.	839	29	Stouffville.	4 b. Utica. 692
10	Burford.	844	36	Ballantrae.	4 b. Utica.
14	Harley.	9. Cornif. & 8. Orisk. 837	38	Vivian.	"
16	Hatchley.	"	42	Mt. Albert.	4 a. Trenton.
21	Norwich.	" 844	49	Ravenshoe.	"
22	G.B. & L.E. Cross.	"	54	Sutton.	"
25	Middletown line.	"	57	Jackson Point.	"
27	Springford.	" 822	34	Goodwood.	4 b. Utica. 1090
32	Can. S. Ry. Cross.	" 797	41	Uxbridge.	4 a. Trenton. 877
34	Tilsonburg. ¹⁶⁶	" 785	45	Marsh Hill.	"
	Tilsonburg Jun.	"	49	Wick.	" 856
			50	Blackwater.	"
			53	Sunderland.	" 851
			59	Cannington.	" 845
			63	Woodville.	" 895
			65	Lorneville Junc.	" 881
			67	Argyle.	" 860
			70	Eldon.	" 870
			73	Portage Road.	" 911
			75	Kirkfield.	" 892
			78	Victoria Road.	" 837
			84	Corson's Cross'g.	"
			87	Coboconk.	" 847
				Port Hope Junc.	"
			0	Port Hope.	"
			5	Quay's.	" 481
			8	Perrytown.	" 652
			9	Garden Hill.	"
			14	Summit.	" 910
			18	Millbrook.	" 772
			23	Fraserville.	"
			31	Peterborough.	" 650
			24	Bethany.	"
			26	Brunswick.	"
			28	Franklin.	"
			45	Omeme.	"
			49	Reaboro.	"
			56	Lindsay.	" 860
			62	Mariposa.	" 854
			68	Manilla Junc.	" 955
			75	Blackwater.	" 881
			77	Sunderland.	" 845
			83	Cannington.	"
			87	Woodville.	" 896
			62	Cambray.	" 926
			73	Grass Hill.	"
			65	Lorneville Junc.	" 881
			73	Beaverton.	" 763
			77	Gamebridge.	" 797
			81	Brechin.	" 757

Welland Division.		
Connecting Lakes Erie and Ontario.		
Port Dalhousie to Port Colborne.		
	Toronto, G. T. R.	255
	Hamilton.	255
0	Port Dalhousie.	5 a. Medina and Oneida. 375
3	St. Catharines. ¹⁶⁸	"
5	Merrittton.	5 c. Niagara.
8	Thorold. ¹⁶⁹	" 553
10	Allanburgh.	5 d. Guelph. 592
11	Allanburgh Jn.	"
13	Port Robinson.	6. Onondaga. 589
17	Welland.	" 602
20	Welland Junc.	"
24	Humberstone.	"
25	Pt. Colborne.	9. Cornif. & 8. Orisk. 586
	Buffalo.	"

Canada Atlantic Railway.		
0	Montreal. ²¹⁰	
38	Coteau.	3 c. Chazy. 161
42	St. Pylcarpe.	"
53	Glen Robertson.	"
61	Alexandria, Ont.	4 a. Trenton.
68	Kenyon.	"
72	Maxville.	"
70	Roxboro Grav. P.	"
87	Casselman.	"
94	South Indian.	4 c. Hudson River.
105	Eastman's Sp'gs	4 b. Utica.
116	Ottawa. ²¹⁶	"
	Chaudiere Falls	4 a. Trenton.

Grand Trunk Railway.		
Midland Division.		
0	Toronto.	
	(Union Station).	4 c. Hudson River. 255
1	Don.	" 253
9	Scarboro Junc.	" 547
14	Agincoourt.	" 569

¹⁶⁸. St. Catharines. Brines obtained in artesian wells here, but too impure for manufacture of salt. Mineral water.

¹⁶⁹. Thorold. Good section of Clinton and Niagara in cutting of Welland Canal. Fossils. A band of argillaceous limestone eight feet thick, in the Niagara, yields an excellent cement.

¹⁷⁰. Madoc. Mines of magnetic iron-ore. A blast-furnace was at one time in operation in Madoc Village, but the ore is now exported. This is the typical region of the Hastings series of the Laurentian.

Grand Trunk Railway— Midland Division—Con.			Ms. | Whitby and Haliburton Branches.		
84 Schepeler.	4 a. Trenton.		0 Whitby Junc.		
88 Uptergrove.	"		1 Whitby.	4 b. Utica.	288
91 Atherly.	"		6 Brooklin.	"	539
93 Couchiching.	"		10 Myrtle.	"	
94 Orillia.	"		13 High Point.	4 a. Trenton.	
98 Silver Creek.	"		15 Manchester.	"	
102 Uhthoff.	"		17 Prince Albert.	"	839
105 Foxmead.	"		19 Port Perry.	"	
106 Alma.	"		26 Seagrave.	"	
109 Coldwater.	"		28 Sonya.	"	
112 Fesserton.	"		32 Manilla.	"	965
114 Waubauskene.	"		33 Manilla Junc.	"	
116 Sturgeon Bay.	"		38 Mariposa.	"	884
120 Victoria Harbor.	"		42 Ops.	"	
124 Old Fort.	"		45 Lindsay.	"	851
128 Midland.	"		52 Cameron.	"	
			56 Halls.	"	
Peterborough and Lakefield Branch.			59 Fenelon Falls.		
0 Pt. Hope.	4 a. Trenton.	481	64 Fells.	4 a. Birdseye & Black Riv.	
5 Quay's.	"		69 Retties.	1 a. Laurentian.	
8 Perrytown.	"	652	78 Kinmount.	"	
9 Garden Hill.	"		80 Miles R'y Junc.	"	
14 Summit.	"	910	88 Minden.	"	
18 Millbrook.	"	772	92 Ingoldsby.	"	
23 Fraserville.	"		94 Dysart.	"	
31 Peterborough.	"	650	99 Gould's.	"	
33 Auburn Mills.	"		101 Haliburton.		
35 Nassau Mills.	"		Toronto to Lindsay, Peterboro., and Port Hope.		
40 Lakefield.	"		0 Toronto.	4 c. Hudson Riv.	254
			1 Don.	"	253
Belleville Branch.			10 Scarboro Junc.	"	547
Montreal. ²¹⁰			15 Agincourt.	"	569
0 Belleville.	4 a. Trenton.	286	18 Milliken's.	"	561
4 Corbyville.	"		21 Unionville.	"	577
9 Foxboro.	"		24 Markham.	"	640
13 Holloway.	"		29 Stouffville.	4 b. Utica.	892
15 N. Hastings Jn.	"	516	35 Goodwood.	"	1092
20 Stirling.	"	415	42 Uxbridge.	4 a. Trenton.	277
27 Hoards.	"		46 Marsh Hill.	"	
33 Cambellford.	"	507	50 Wick.	"	866
44 Hastings.	"	636	51 Blackwater.	"	
50 Birdsall's.	"		58 Manilla Junc.	"	
53 Blezard's.	"		63 Mariposa.	"	884
57 Keene.	"		67 Ops.	"	
66 Peterborough.	"	650	70 Lindsay.	"	851
			76 Reaboro.	"	
Madoc Branch.			80 Omeme.	"	
0 Belleville.	4 a. Trenton.	286	85 Franklin.	"	
4 Corbyville.	"		87 Brunswick.	"	
9 Foxboro.	"		89 Bethany.	"	
13 Holloway.	"		94 Peterboro.	"	650
15 N. Hastings.	"	616	102 Fraserville.	"	
17 W. Huntingdon.	"		107 Millbrook.	"	772
20 Ivanhoe.	"		111 Summit.	"	
24 Crookston.	"		116 Garden Hill.	"	
27 Moira Lake.	"		117 Perrytown.	"	652
30 Madoc. ¹⁷⁰	(Lake.)	519	120 Quay's.	"	481
	1 a. Laurentian.	584	125 Port Hope.	"	287
			Port Hope Junc.	"	

tion of the late Mr. Vennor. The rocks consist of quartzites, conglomerates, limestones, micaceous slates, and argillites, and are considered by Dr. Hunt to represent the Lower Taconic. Dr. Hunt also states that Montalban gneisses and mica schists occur in this neighborhood.

Canadian Pacific Railway.			Ms.	Ontario Division.—Main Line.—Con.		
Ms.	Ontario Division.—Main Line.					
0	Smith's Falls Jn.	3 a. Calciferous.		258	Leslie.	5 d. Guelph. 1067
6	Pike Falls.	"		264	Galt. ¹⁵⁹	" 836
12	Perth. ²⁰¹	"		269	Dumfries.	6. Onondaga. 965
21	Bathurst.	1 a. Laurentian. 431		274	Ayr.	" 965
27	Maberly.	"		279	Wolverton.	" 965
37	Sharbot Lake Jn.	"		281	Drumbo.	" 1013
46	Mountain Grove.	"		285	Blandford.	9 a. Corn. and Orlah. ⁹⁷²
51	Arden.	"		288	Innerkip.	" 972
63	Kaladar.	"		294	Woodstock.	" 967
71	Sheffield.	"		299	Beachville.	"
78	Tweed.	4 a. Tren. & 1a. Laur. ⁵⁷¹		303	Ingersoll.	"
87	Ivanhoe. ²⁰²	4 a. Trenton.		308	Putnam.	"
96	Can. Ont. Jn. ²⁰³	"		313	Harrietsville.	"
105	Blairton.	"		319	Belmont.	"
110	Havelock.	"		327	St. Thomas.	10. Hamilton.
116	Norwood.	"		Elora Branch.		
126	Indian River.	"		Toronto. ²⁰⁴		225
134	Peterboro.	"		0	Church's Falls.	5 c. Niagara. 1266
143	Cavanville.	"		5	Erin.	" 1295
151	Manvers.	"		8	Hillsburg.	5 d. Guelph. 1454
155	Pontypool.	" 1064		12	Garafraxa.	" 1452
167	Burketon.	"		17	Douglas.	"
173	Myrtle.	" 887			Spies.	"
182	Claremont.	4 b. Utica. 885		25	Fergus.	" 1267
189	Green River.	"		27	Elora. ²⁰⁶	" 1261
197	Agincourt.	4 c. Hudson River. 571		Orangeville Branch.		
207	North Toronto.	" 406		Toronto. ²⁰⁴		225
211	Toronto Junc.	" 394		0	Streetsville.	5 a. Med. and Onid. ⁴⁹⁹
213	Parkdale.	"		1	Streetsville Jun.	" 563
215	Toronto. ²⁰⁴	" 255		3	Meadowvale.	" 566
213	Lambton.	" 412		5	Churchville.	"
215	Islington.	"		8	Brampton.	" 724
219	Dixie.	"		13	Edmonton.	"
221	Cooksville.	" 393		17	Campb'l's Cross.	"
224	Springfield.	5 a. Medina and Onida.		18	Cheltenham.	"
227	Streetsville.	" 499		21	Riverdale.	"
228	Streetsville Jun.	" 553		25	{ Forks of	} " 1068
231	Trafalgar.	"			Credit. ²⁰⁷	
234	Hornby.	"		28	Church's Falls.	5 c. Niagara. 1260
239	Milton.	" 663		31	Alton.	"
245	Campb'llville. ²⁰⁵	5 c. Niagara. 989		33	Melville Junc.	"
248	McRae's.	5 d. Guelph.		36	Orangeville. ²⁰⁸	5 b. Clin. & 5 c. Nlag. ¹²⁶⁸
251	Schaw.	"				

201. Perth. Potsdam sandstones overlapping Laurentian near here. The peculiar tracks described as *Protichnites* and *Chimacichnites* in quarries in first-named formation. Dalhousie or Cowan mines twelve miles distant. Red hematite. Laurentian.

202. Ivanhoe. To Madoc iron-mines (magnetite and hematite) 6½ miles by road.

203. Central Ontario Junction. Branch line to Coehill Iron Mine, about 40 miles distant. Magnetite at junction of granite and crystalline limestone in Laurentian. To Deloro 7½ miles by road. Marmora gold-mines. Auriferous mispickel in quartz gangue.

204. Toronto. Pleistocene clay (Erie clay), extensively wrought for the manufacture of cream-colored brick.

205. Campbellville. Escarpment of the Niagara limestone here. The outcrop of the Clinton, which is here thirty to forty feet thick, is below it, but generally concealed by talus.

206. Elora. Good sections of Guelph formation in river cliffs.

207. Forks of Credit. Extensive quarries in Medina sandstone, producing a fine reddish freestone of excellent quality.

208. Orangeville. Artemisia gravels fifty miles.

209. Owen Sound. In cliffs along the lake shore good sections, extending from Hudson River through Medina and Clinton formations, with great mass of Niagara limestone capping the plateau. Excellent yellowish-gray stone in unlimited quantity afforded by last-mentioned formation. It has been used in construction of several lighthouses on the lake. Quarries. Fossils. Deposit of yellow ocher near the town. Sections in road-cuttings exhibit relations of Erie and overlying Saugeen clays.

Canadian Pacific Railway—Con.			Ms.	Perth and Smith's Falls.	
Owen Sound Branch.					
0	Tor'to, Union Station.	4 c. Hudson River.	255	0 Smith's Falls.	3 a. Calciferous.
5	Toronto Junc.	"		6 Pike Falls.	"
8	Weston.	"	429	12 Perth. ²⁰¹	1 a. Laurentian.
16	Woodbridge.	"	558	Eastern Division.	
21	Kleinburg.	"	716	Between Montreal, Ottawa, Pembroke, and Sudbury.	
26	Bolton.	"	838		
32	Mono Road.	5 a. Medina.	976	0 Montreal. ²¹⁰	4 a. Trenton.
34	Cardwell Junc.	"		1 Hochelaga.	"
41	Charleston.	5 c. Niagara.	1367	4 Mile End.	"
44	Alton.	"	1298	8 Sault aux Recollets.	"
45	Melville Junc.	"		11 St. Martin.	3 c. Chazy.
48	Orangeville.	5 c. Nia. & 5 b. Clin.	1398	12 St. Martin Junc.	"
52	Orangeville Jun.	5 d. Guelph.	1616	17 Ste. Rose.	3 a. Calciferous.
56	Laurel.	"		19 Ste. Therese.	"
60	Crombies.	"		27 St. Augustin.	"
64	Shelbourne.	"	1629	32 Ste. Scholastique	"
68	Melancthon.	"		37 St. Hermas.	"
72	Corbettown.	"		43 Lachute. ²¹¹	"
76	Dundalk.	"	1701	48 St. Philippe.	"
81	Proton.	"	1613	57 Grenville.	3 c. Chazy.
86	Flesherton.	5 c. Niagara, 6 m.	1557	59 Calumet.	3 a. Calciferous.
92	Markdale.	5 d. Guelph.	1359	64 Pointe au Chene.	1 a. Laurentian.
98	Berkeley.	"	1329	74 Montebello.	"
102	Williamsford.	"	1212	78 Papineauville ²¹²	"
106	Arnott.	"		83 N. Nation Mills.	"
109	Chatsworth.	5 c. Niagara, 13 m.	944	90 Thurso.	2 b. Potsdam.
114	Rockford.	"	912	98 Rockland.	1 a. Laurentian.
118	St. Vincent's R'd.	"		99 Buckingham ²¹³	"
122	Owen Sound. ²⁰⁹	"	586	103 L'Ange Gardien.	"
				109 E. Templeton ²¹⁴	"
				114 Gatineau.	"
				118 Hull. ²¹⁵	4 a. Trenton.
				120 Ottawa, Ont. ²¹⁶	"
				122 Skeads. ²¹⁷	3 c. Chazy.
				125 Britannia.	"
				129 Bell's Corners.	"
				135 Stittsville.	"
				139 Cleary's.	"
				144 Ashton.	"
				146 Appleton.	3 a. Calciferous.
				149 Carleton Junc.	"
				155 Almonte.	"
				159 Snedden's.	3 c. Chazy.
				164 Pakenham. ²¹⁸	2 b. Potsdam.
				172 Arnprior. ²¹⁹	1 a. Laur. & 3 a. Calcif.
				175 Braeside.	1 a. Laurentian.
				178 Sand Point.	5 and 7. Silurian.
				184 Castleford.	"
Teeswater Branch.					
	Toronto. ⁴		255		
0	Orangeville.	5 b. Clin., & 5 c. Ni., Ar- tem. grav., 45 m.	1398		
4	Orangeville Jn.	5 d. Guelph.	1616		
7	Amaranth.	"	1546		
10	Waldemar.	"	1498		
12	Luther.	"	1544		
23	Arthur.	"	1528		
30	Kenilworth.	"	1486		
38	Mt. Forrest.	"	1350		
44	Pages.	6. Onondaga.	1283		
48	Harriston.	"	1246		
56	Fordwich.	9 c. Corn. and Oris.	1200		
60	Gorrie.	"	1123		
62	Wroxeter.	"	1123		
69	Wingham Road.	"			
74	Teeswater.	"	1024		

²¹⁰ Montreal. The region about Montreal is one of much geological interest. The following formations are represented in the immediate vicinity of the city: Pleistocene, Lower Helderberg, Hudson River, Utica, Trenton, and Chazy. The Chazy is here about two hundred feet thick, and consists chiefly of limestone. Exposures may be seen north of the city, as on the St. Lawrence road, also at Caughnawaga, where there are extensive quarries. The Trenton is here about six hundred feet thick, and is composed of gray and blackish limestones for the most part. Good exposures, with numerous fossils, in quarries at the Mile End and at Pointe Claire. At the last-named locality, Black River beds occur. At the Reservoir, and at many points in Mount Royal Park, limestones, also of Trenton age, but differing in appearance from those of the above-mentioned localities, are well shown. The Chazy and Trenton formations of the vicinity supply most of the building-stone used in the city. The Utica shales may be seen at the upper end of St. Helen's Island and elsewhere, but owing to their soft character are usually concealed. The Lower Helderberg occurs in small outcrops only, the most considerable being on St. Helen's Island, and consisting of a dolomitic breccia, which is trav-

Canadian Pacific Railway— Eastern Division—Con.		Eastern Division—Con.	
Between Montreal, Ottawa, Pembroke, and Sud- bury.		Between Montreal, Ottawa, Pembroke, and Sud- bury.	
188 Russell's.	1 a. Laurentian.	319 Mattawa.	1 a. Laurentian.
191 Renfrew.	"	329 Renton.	"
199 Haley's.	"	342 Rutherglen.	"
206 Cobden.	"	345 Callander.	"
212 Snake River.	"	349 Nosbousing.	"
216 Graham's.	"	357 Thorncliff.	"
219 Government R'd	"	364 North Bay.	"
225 Pembroke. ²²⁰	"	375 Beaucage.	"
236 Petewawa.	"	381 Meadowside.	"
246 Chalk River.	"	388 Sturgeon Falls.	"
252 Weston.	"	399 Verner.	"
258 Bass Lake.	"	410 Veuve River.	"
265 Moorlake.	"	413 Veuve.	"
273 Mackey's.	"	420 Mark Stay.	"
277 Rockcliffe.	"	428 Stinson.	"
287 Bissett.	"	432 Wahnapiatae.	"
299 Deux Rivières.	"	438 Romford.	1 b. Huronian.
309 Klock.	"	444 Sudbury. ²²¹	"

ersed by dikes of nepheline-basalt. The Pleistocene is here divided into—1. Boulder clay; 2. Leda clay; 3. Sargis sand. The city being built on these deposits, frequent opportunities of examining them are obtained in excavations for drains, cellars, etc. They are in some places highly fossiliferous, and are well shown in some of the quarries at Mile End, where they overlie glaciated surfaces of Trenton limestone. Near Côte des Neiges village, a Pleistocene beach with marine shells at an elevation of 470 feet.

Mount Royal is an intrusive mass, composed principally of diabase, but toward the west end is an important and more recent mass of nepheline-syenite, which is well seen at the "Corporation Quarry." Both the eruptive rock and the surrounding limestones are traversed by numerous dikes. (From "Sketch of Geology of Montreal and Environs," by Dr. B. J. Harrington, in "Hand-Book for the Dominion of Canada." Dawson Brothers, Montreal.)

In Peter Redpath Museum, McGill University, good local and general geological collections.

211. Lachute. The Paleozoic rocks here form a narrow belt of flat country bordering the Ottawa River. The Laurentian highlands may be seen to the north of this part of the railway line, and gradually approach the river.

212. Papineauville. Côte St. Pierre, one of the best localities for *Esocoon*, is reached from this station. Twelve miles by stage to St. André, thence three miles to Côte St. Pierre.

213. Buckingham is the chief point of shipment on the railway of the apatite mined at numerous places within a radius of twenty to thirty miles. Large quantities of apatite may frequently be seen piled here. Extensive deposits of plumbago near Buckingham are not at present worked.

214. East Templeton. This is also an important point of shipment of apatite.

215. Hull. Within a few miles of Hull is an important deposit of magnetic iron-ore, which has been somewhat extensively mined and is exported. Also hydraulic limestone. (See note on Ottawa.)

216. Ottawa. The Laurentides, but a few miles distant, belong to the lower and middle divisions of Sir William Logan's Laurentian system. These two formations, consisting chiefly of gneisses, granites, crystalline limestones, etc., are overlain unconformably by continuous and perfectly conformable series of sedimentary strata of the Cambro-Silurian system, embracing the Potsdam (of the Ottawa and Adirondack regions), Calciferous, Chazy, Bird's Eye and Black River, Trenton, Utica, and Hudson River formations. It was in these measures that the late Mr. E. Billings made his earliest paleontological researches, and these have proved ever since, as then, to be a rich hunting-ground to the paleontologist. There are extensive and varied deposits of marine clays and sands, gravels, boulders, etc., of Pleistocene age. The Leda clay of Green's Creek, Gloucester, six or seven miles from the city, abounds in nodules holding remains of the seal, fishes, insects, shells, and plants. The total number of species representing the fossil fauna and flora of this locality does not fall far short of three hundred. Brigham's Quarries, Hull, through which the Canadian Pacific Railway runs, are undoubtedly the best Cambro-Silurian crinoid quarries in America. Deposits of magnetite, apatite, and baryta occur within a short distance of Ottawa. Both the Black River and Trenton formations yield excellent limestones for lime or building purposes, while the Chazy of Nepean afforded much of the material (sandstones) used in the erection of the Parliament buildings. A bed of hydraulic limestone occurring at the top of the Chazy has been worked and employed in the manufacture of the "Hull cement." (Note by Mr. H. M. Ami.) In Ottawa the museum and offices of the Geological Survey of Canada. Excellent collection of Canadian rocks, minerals, and fossils.

217. Skeads. Most of the sandstone used in the construction of the Parliament buildings, Ottawa, was quarried near here.

218. Pakenham. Pleistocene deposit, containing mixture of marine and fresh-water shells near Pakenham Mills, 266 feet above the sea level.

219. Arnprior. Bluish gray-banded Laurentian marble somewhat extensively quarried near here.

220. Pembroke. Excellent sections of Laurentian in railway cuttings for many miles west of this point. The rocks shown "are for the most part highly characteristic red, gray, and dark-banded gneisses; felspathic and hornblende, and frequently garnetiferous and micaceous. There are also some large bands of gray and white crystalline limestone; but none of these are exposed along the line of

Canadian Pacific Railway—			Ms. |	St. Jerome Branch—Con.		
West of Sudbury Junction.						
444	Sudbury. ²²¹	1 b. Huronian.		38	St. Jerome. ²²² { 1 c. Norian or Upper Laurentian. ²¹¹	
455	Chelmsford.	"		39	New Glasgow.	"
460	Vermilion.	"		St. Lin Branch.		
463	Phelan's Pit.	"		0	Montreal. ²¹⁰	4 a. Trenton.
478	Archer.	"		19	Ste. Therese.	3 a. Calciferous.
501	Pogomasing.	"		21	St. Lin. Junc.	4 a. Trenton.
510	Spanish Forks.	1 a. Laurentian.		24	Mascouche.	"
515	No. 23 Siding.	"		27	Ste. Anne.	"
518	West Branch.	"		30	Les Plaines.	3 c. Chazy.
580	Pass Landing.	"		34	St. Lin.	3 a. Calciferous.
532	Biscotasing.	"		Aylmer Branch.		
Gap of 850 miles from Biscotasing to Port Arthur, in which no stations yet permanently located, though road for the greater part built.—Dec., 1884.				0	Aylmer.	3 c. Chazy. ²²²
St. Eustache Branch.				2	Duchesne Mills.	"
0	Montreal.	4 a. Trenton.		5	Belmonte.	"
19	Ste. Therese Jn.	3 a. Calciferous.		7	Hull.	4 a. Trenton. ¹⁸⁵
27	St. Eustache.	"		9	Ottawa.	"
St. Jerome Branch.				Brockville Line.		
0	Montreal. ²¹⁰	4 a. Trenton.		0	Carleton Junc.	3 a. Calciferous.
1	Hochelaga.	"	70	5	Beckwith.	"
4	Mile End.	"	225	9	Franktown.	2 c. Potsdam.
8	Sault aux Recollets.	"		15	Welsh's.	"
11	St. Martin.	3 c. Chazy.		18	Smith's Falls.	3 a. Calciferous.
12	St. Martin Jn.	"		21	Story's.	"
17	Ste. Rose.	3 a. Calciferous.	85	25	Irish Creek.	"
19	Ste. Therese.	"		30	Walford.	"
21	St. Lin Junc.	4 a. Trenton.		32	Bell's.	"
27	St. Janvier.	3 a. Calciferous. ²²⁰		34	Jelly's.	"
				36	Bellamy's.	"
				39	Clark's.	"
				41	Fairfield.	"
				46	Brockville.	2 c. Potsdam.

the railway west of Mattawa, where it leaves the valley of the Ottawa River." (Dr. A. R. C. Selwyn, in "Descriptive Sketch of Geology, etc., of Canada.")

221. Sudbury. "After passing the Wahnapipe River bridge, the Huronian rocks commence, with a series of flinty felsites or felsitic quartzites, succeeded by dark-gray quartzose conglomeritic beds; also massive crystalline diorites, red, fine-grained syenites, and a great variety of highly altered volcanic agglomerates, felspathic and dioritic." (*Ibid.*)

From Sudbury the Algoma Mills branch runs over Huronian rocks to the shore of the lake. The main line westward, to Port Arthur by the north shore of Lake Superior, will be in operation soon. From Sudbury it passes for about seventy miles over Huronian rocks. Thence to within about fifteen miles of the Nepigon River the Laurentian is the most widely spread formation, though intersected by belts of Huronian and with extensive granitic and dioritic intrusive masses. On both sides of the Nepigon, rocks of the Nepigon series (Cambrian) are found, and are separated by a mass of intrusive granite only from the Animikie rocks of the vicinity of Port Arthur.

222. St. Jerome. The rocks of the Norian or Upper Laurentian may be seen here, but are more typically shown at New Glasgow village, six miles distant, and the present terminus of the railway.

223. The numbers affixed to the Animikie, Keweenaw, and Upper and Lower Potsdam, in the table on p. 58, are those used for convenience in this chapter, but are not intended to affirm the precise correlation of these with other formations similarly numbered in adjacent states.

III. Manitoba and North-West Territory.

Including districts of Assinibola, Alberta, Saskatchewan, and Athabaska, to base of Rocky Mountains.

List of Geological Formations.

	{ Alluvium. Lake deposits of Red River Valley and Peace River, etc. Stratified Sands and Gravels, and Moraines.			
20. QUATERNARY.	{ Boulder Clay or Till.		{ Upper Boulder Clay. Interglacial Lake Deposit. Lower Boulder Clay. Shingle Beds.	{ Of Southern Alberta, etc.
19. TERTIARY.	Miocene. Conglomerate Sandstone and Argillite of Cypress Hills, etc.			
18. CRETACEO-TERTIARY, LARAMIE.	{ Porcupine Hill Series. Willow Creek Series. St. Mary's River Series.	{ Of Southern Alberta.	{ Fort Union. Laramie.	{ Wapiti River Group.
18. CRETACEOUS.	{ Fox Hill Series. Pierre Series. Belly River Series. Niobrara or Benton Series.	{ Of Alberta.	{ Fox Hill Ser. Pierre Series. Niobrara Series. Benton Series?	{ Of Manitoba, etc. Smoky River Group. Dunvegan Group. Ft. St. John Group.
9-12. DEVONIAN.	Limestones of Manitoba Lake, etc.			
4. SILURO-CAMB.	Trenton Group. (Limestones of Winnipeg Lake, Red River Valley, etc.)			
1 b. HURONIAN.				
1 a. LAURENTIAN.				

Canadian Pacific Railway.—Con.			Ms. | Winnipeg and Port Arthur Section.—Con.		
Western Division.					
Ms.	Winnipeg and Port Arthur Section.				
0	Port Arthur. ²²⁴	Animikie 2. L. Camb.	221	Oxdrift.	1 a. Laurentian.
6	Fort William.	" 603	231	Eagle River.	" 1193
17	Murillo.	" 944	241	Vermilion Bay.	" 1216
27	Kaministiquia.	1 b. Huronian. 1010	249	Gilbert.	" 1214
37	Finmark.	{ 1 b. Huronian and 1 a. Laurentian. 1177	256	Parrywood. ²²⁶	" 1296
44	Buda. ²²⁵	1 a. Laurentian. 1147	272	Hawk Lake.	" 1296
55	Nordland.	" 1550	284	Beaver.	" 1173
59	Dexter.	"	288	Roseland.	Granite, 4 miles. 1195
65	Linkooping.	" 1531	297	Rat Portage. ²²⁶	1 b. Huronian, 6 m. 1084
75	Savanne.	" 1503	300	Keewatin. ²²⁷	1 a. Laurentian. 1073
86	Upsala.	1 b. Huronian. 1559	308	Ostersund.	1 a. Laurentian. 1102
93	Carlstadt.	1 a. Laurentian. 1513	313	Deception.	" 1133
103	Bridge River.	" 1540	320	Kalmer.	" 1214
115	English River.	1 b. Huronian. 1514	328	Ingolf.	" 1191
123	Martin.	1 a. Laurentian. 1554	(Manitoba.)		
133	Bonheur.	" 1527	338	Telford.	" 1056
144	Falcon.	" 1504	348	Renne.	" 1050
151	Ignace.	" 1448	359	Darwin.	" 968
160	Butler.	" 1420	368	Whitemouth.	" 904
170	Raleigh.	1 b. Huronian. 1437	374	Shelly.	" 926
180	Taché.	" 1263	384	Monmouth.	" 876
190	Brulé.	" 1252	394	Beausejour.	20. Alluvium. 811
202	Wabigoon.	" 1252	400	Tyndall.	" 793
209	Barclay.	" 1248	408	Selkirk. ²²⁸	" 740
			414	Gonor.	"
			421	Bird's Hill.	"
			428	Winnipeg Junc.	"
			429	Winnipeg. ²²⁹	" 37

Canadian Pacific Railway— <i>Con.</i>				Ms. : Winnipeg and Rocky Mountain Section— <i>Con.</i>			
Ms. | Winnipeg and Rocky Mountain Section.							
0	Winnipeg. ²²⁹	20. Alluvium.	787	188	Brandon. ²³¹	{ 20. Glacial drift over- lying 18. Cretaceous, 290 m.	
2	Air Line Junc.	"					1170
7	Bergen.	"		141	Kenmay.	"	1335
15	Rosser.	"	772	149	Alexander.	"	1366
29	Marquette.	"	782	158	Griswold.	"	1399
35	Reaburn.	"	781	166	Oak Lake.	"	1391
40	Poplar Point.	"	790	180	Virden.	"	1420
49	High Bluff.	"	806	197	Elkhorn.	"	1606
56	Portage la	{		211	Fleming.	"	1760
	Prairie.		"	830	219	Moosomin.	"	1860
64	Burnside. ²³⁰	"	843	226	Red Jacket.	"	1893
72	Bagot.	{ 20. Glacial drift, prob- ably overlying Cre- taceous.		235	Wapella.	"	1907
			"	912	243	Burrows.	"	1924
77	McGregor.	"	937	249	Whitewood.	"	1939
85	Austin.	"	981	264	Broadview.	"	1936
93	Sidney.	"	1208	279	Grenfell.	"	1933
106	Carberry.	"	1233	286	Summerberry.	"	1914
114	Sewell.	"	1230	294	Wolseley.	"	1926
128	Chater.	"	1186	302	Sintaluta.	"	1960
				312	Indian Head.	"	1900

224. Port Arthur. Good geological headquarters for examination of Nepigon, Animike, and Huronian series. Silver-mines in neighborhood and fine crystalline minerals. Attractive scenery. The formations assigned to the various stations on this line, from Port Arthur to Rat Portage, may in some cases be in error, as no geologically colored map showing the precise positions of stations is at present available. After leaving the Animike of the lake shore, the rocks are all Laurentian or Huronian, with intrusive granitic masses. Fine sections of the rocks of these series, and the dikes and veins traversing them, occur in numerous cuttings.

225. Buda. The reddish color of the drift deposits, characteristic of the neighborhood of Lake Superior and northeast portion of Minnesota, ends about here.

226. Rat Portage. On northern extremity of Lake of Woods good headquarters for excursions on lake, where Laurentian and Huronian rocks are displayed in almost continuous sections along the shores. Gold-mines. Lake extremely picturesque, with innumerable islands. Both west and east from Rat Portage, on the railway, but more particularly to east, very fine examples of perched blocks and glaciated rock surfaces. Numerous cuttings in Laurentian, Huronian, and drift deposits. From Rat Portage, in a distance of about forty miles eastward (to near Parrywood station), the succession of rocks traversed is as follows: Laurentian, Int. granite, Laurentian, Huronian, Laurentian, Huronian, Laurentian.

227. Keewatin. Railway twice crosses boundary between Laurentian and Huronian between Ostersund and this station. Here good opportunity of examining junction.

228. Selkirk. Quarries close to station in Galena limestone. Fossils.

229. Winnipeg. The alluvium of the Red River Valley is a deposit of a former great lake of Post-Glacial age, which Mr. Warren Upham has proposed to name Lake Agassiz. The shore lines of this body of water may still be traced, at various levels, to the east and west of the valley. The lake must have received the waters of the Saskatchewan, and had its outflow southward to the Mississippi. The alluvial deposits are of great thickness, and consist above of silty or loess-like material; below frequently of plastic clays more or less distinctly laminated. The upper layers make excellent cream-colored brick. Alluvium completely conceals the underlying rocks in this valley; but these are, doubtless, for the most part Silurian limestones like those of Lake Winnipeg.

230. Burnside. In 1874 a boring was carried out at Rat Creek, near this place, by the Geological Survey. The following section was obtained: Blue clay, 70 feet; sand, gravel, and stones, with water, 18 feet; white limestone (probably Devonian), 42 feet; gray crystalline rock (Laurentian or Huronian), 77 feet. West of Burnside the country rises considerably, and this point may be assumed as the western limit, on this line, of the Red River Valley alluvium. Not far west of this the edge of the Cretaceous probably overlaps the old rocks found in the above-mentioned boring, but the whole surface is completely masked by drift deposits. (See note on Brandon.)

231. Brandon. From Winnipeg to Brandon, alluvium and glacial drift, the latter consisting of boulder-clay overlain by stratified sands and gravels. The western edge of the alluvial plain of the Red River Valley is indefinite on the line of the railway, which follows the wide depression of the Assiniboine. To the southeast and northwest it is marked by the escarpment of the second prairie steppe or plateau, constituting Pembina, Riding and Duck "Mountains," and the Porcupine and Basquia Hills. Sands and gravels connected with the western edge of "Lake Agassiz" may be observed in several places. The underlying rocks are completely concealed by the drift deposits, but the Cretaceous probably overlaps the Silurian and Devonian rocks of the Winnipeg basin a few miles west of Austin station. At Brandon the Assiniboine Valley itself is entered. It may be taken as typical of the wide trough-like valleys generally characterizing the rivers of the second and third prairie plateaus. Small exposures of Pierre shales (Cretaceous) in some parts of the Assiniboine Valley.

232. Moose Jaw. Observe the line of the Missouri Côtéau in the distance, to the southwest.

233. Mortlach. From Brandon to Mortlach there are no exposures of the underlying rock in the vicinity of the railway, and over the second prairie plateau generally, these are seen as a rule only in the river valleys. To Mortlach, however, the whole plain is, with little doubt, based on the Pierre

Canadian Pacific Railway— Winnipeg and Rocky Mountain Section.			Winnipeg and Rocky Mountain Section.		
Ms.	Continued.		Ms.	Continued.	
324	Qu'Appelle.	{ 20. Glacial drift over-lying 18. Cretaceous, 2110	452	Chaplin.	{ 20. Alluv. overlying 18. Cretaceous. 2178
332	McLean.	{ " 2258	461	Ernfold. ²³⁵	{ 20. Glacial drift over-lying 18. Cretaceous. 2264
341	Balgonie.	{ " 2164	471	Morse. ²³⁵	{ " 2260
347	Pilot Butte.	{ " 1993	480	Herbert.	{ " 2287
356	Regina.	{ " 1862	489	Rush Lake.	{ 20. Glacial drift over-lying 18. Pierre shales. 2276
373	Pense.*	{ " 1854	496	Waldec.	{ " 2323
381	Belle Plaine.	{ " 1877	510	Swift Cur'nt. ²³⁶	{ 18. Pierre Shales, 111 miles. 2400
390	Pasquia.	{ " 1851	519	Leven.	{ " 2440
398	Moose Jaw. ²³²	{ " 1743	529	Goose Lake.	{ " 2441
406	Boharm.	{ " 1768	538	Antelope.	{ " 2532
414	Caron.	{ " 1817	546	Gull Lake. ²³⁷	{ " 2539
423	Mortlach. ²³³	{ 20. Glacial drift over-lying Ft. Union Lar- amie. 1936	554	Cypress.	{ " 2628
432	Parkbeg. ²⁵⁹	{ " 1958	565	Sidewood.	{ " 2431
443	Secretan. ²³⁴	{ " 2258	575	Crane Lake.	{ " 2544
			586	Colley.	{ " 2485

* 18. Pierre Shales struck in bore-hole.

shales of the Cretaceous. The boulder-clay, with overlying stratified drift, and fine alluvium marking sites of former lakes or ponds, cover the entire country. At or near Mortlach the increasing elevation of the plain brings in the base of the Fort Union Laramie, but there are no exposures near the railway. No western limit is given for these beds, as their precise extent has not been determined. They do not, however, extend on the line as far as the Old Wives Lakes. They are well shown to the southeast on the Souris River, and there hold numerous seams of lignite.

234. Secretan. At Secretan the drift hills of the Missouri Côtéau are well displayed. The Côtéau belt, where crossed by the railway, is not so well defined as near the 49th parallel, but may be said to extend from Parkbeg station westward to a point four or five miles beyond Secretan. See Note 252.

235. Morse. Between Ernfold and Morse a second line of Côtéau-like hills is crossed. The Old Wives Lakes (saline) appear to occupy an interval between this branch of the Côtéau and that above described. They have evidently at one time been much more extensive, and have no outlet.

236. Swift Current. The Pierre shales (Cretaceous) are exposed on the stream a short distance north of the line, and in valleys 1½ miles northeast from station. In general the deposits of Glacial period and subsequent alluviums only are seen near the line.

237. Gull Lake. Sections of Fox Hill sandstones overlying Pierre shales in Cypress Hills, a few miles south of this station. The Cypress Hills constitute a remarkable plateau, which may be seen extending to the south of the railway for many miles east and west. It is capped by Miocene Tertiary beds, of which the most characteristic is a conglomerate formed of well-rolled pebbles of the harder rocks of the Rocky Mountains.

238. Walsh. The dividing-line between the Pierre shales and the underlying Belly River series probably passes between Forbes and Walsh stations; but, as elsewhere in this region, the rocks are generally concealed by the later drift deposits.

239. Irvine. Half a mile south of station fine sections showing Pierre shales, with coaly layers near base, overlying Belly River series. Fossils.

240. Medicine Hat. Good sections of boulder-clay and drift in railway cuttings to eastward.

241. Stair. One mile southward from this station, on the banks of the Saskatchewan, lignite coal is mined in rocks of the Belly River subdivision of the Cretaceous. There are two seams, of which the lower (about five feet thick) is worked. Fine exposures of rocks all along this part of the river.

242. Langevin. In boring for water at this station, a copious flow of combustible gas has been tapped.

243. Cassels. Here also combustible gas in large quantities flows from well. The Pierre shales must overlap the Belly River series near here, but the surface shows drift deposits only. On the river, a few miles to the south, the base of the Pierre is marked by a fine seam of coal 4' 6" thick.

244. Bassano. Good sections showing base of Laramie and top of Pierre, four miles southwest on Bow River, where a coal-seam 4' 4" thick occurs.

245. Crowfoot. Lignite coal 9' thick exposed on Bow River to south, and underlying Crowfoot at depth of about 100'. Shaft sunk to coal north of track, 135 feet deep.

246. Calgary. Excellent exposures of Laramie rocks along Bow River to south of line from Bassano to this point. The plain, as seen from the railway, a gently undulating drift-covered surface, showing no exposures of the underlying rocks. At bridge across the Elbow River, at Calgary, massive Laramie sandstones. Calgary is the farthest western point on this parallel to which Laurentian fragments from the northeastward have been traced. The boulders and gravel farther west appear to be entirely derived from the Rocky Mountains or of local origin.

247. Radner. For about twenty-eight miles west of Calgary the railway, following the Bow River, passes over Laramie rocks, nearly horizontal, but forming the northern extension of a wide synclinal occupied farther south by the Porcupine Hills. Between Cochrane and Radner the belt of disturbed and flexed rocks which lie along the base of the mountains, constituting the foot-hill country, is entered. Numerous fine sections of Cretaceous and Laramie in river-banks to Kananaskis.

248. Kananaskis. The Cretaceous or Laramie sandstones are here nearly flat, but appear to dip

Canadian Pacific Railway— Winnipeg and Rocky Mountain Section.			Winnipeg and Rocky Mountain Section.	
Ms.	Continued.		Ms.	Continued.
596 Maple Creek.	18. Pierre Shales.	2470	938 Silver City. ²⁵²	{ 9 and 14. Devono-Car- boniferous. 4624
615 Forbes.	"	2406	945 Eldon. ²⁵³	2-4. Cambrian. 4782
628 Walsh. ²³⁸	{ 18. Belly River Series.	2407	955 Laggan. ²⁵⁴	" 5005
638 Irvine. ²³⁹	{ 107 m.	2469	962 Stephen. ²⁵⁵	{ 9 & 14. Devono-Car- bonif. 5296 (summit).
651 Dunmore.	"	2373	British Columbia boundary line.	
660 Medicine Hat ²⁴⁰	"	2142	Emerson Section.	
668 Stair. ²⁴¹	"	2403	St. Vincent.	20. Alluvium.
686 Suffield.	"	2471	0 Emerson.	"
695 Langevin. ²⁴²	"	2471	10 Dominion City.	"
704 Kininvie.	"	2405	18 Arnaud.	"
713 Tilley.	"	2438	26 Dufrost.	"
753 Cassils. ²⁴³	18. Pierre Shales.	2493	35 Otterburne.	"
750 Lathom.	"	2534	42 Niverville.	"
757 Bassano. ²⁴⁴	18. Laramie.	2563	54 St. Norbert.	"
766 Crowfoot. ²⁴⁵	"	2672	63 St. Boniface.	"
776 Cluny.	"	2823	64 Winnipeg Junc.	"
785 Gleichen.	"	2926	66 Winnipeg.	"
801 Strathmore.	"	3005	Manitoba and Northwestern Railway of Canada.	
819 Langdon.	"	3268	0 { Portage la	{ Alluvium overlying
830 Shepard.	"	3344	9 { Prairie.	{ Devonian.
839 Calgary. ²⁴⁶	"	3388	9 Macdonald.	"
848 Keith.	"	3522	16 Westbourne.	"
862 Cochrane.	"	3712	26 Woodside.	"
872 Radnor. ²⁴⁷	{ 18. Cretaceous, and	3825	34 Gladstone.	"
881 Morley.	{ 18 Laramie.	4032	51 Arden.	"
893 Kananaskis. ²⁴⁸	"	4170	61 Neepawa.	Drift overlying Cretac.
901 The Gap. ²⁴⁹	9 & 14. Devono-Car.	4198	66 Stony Creek.	"
906 Canmore. ²⁵⁰	18 Cretaceous.	4263	78 Minnedosa.	"
914 Duthil.	"	4342		
919 Banff. ²⁵¹	"	4531		
927 { Castle Mount- ain.	{ 9 and 14. Devono-Car- boniferous.	4511		

below the Paleozoic limestones of the mountains, which are seen in cutting just beyond this station. Above cutting, well-marked glaciation due to former Bow Valley glacier. (The railway here enters the Rocky Mountains.) Below mouth of Kananaskis River, fine falls over Cretaceous sandstone on Bow River. The great limestone series of the mountains, characterized above as Devono-Carboniferous, is the most important constituent of the range in this part of its length. No separation, except quite locally, has yet been found possible between the Devonian and Carboniferous parts of the series.

249. The Gap. The valley beyond this point becomes quite wide, and turns to the northwest, following a belt of Cretaceous rocks.

250. Canmore. The valley here floored by the Cretaceous rocks above referred to, while limestones form the mountains on both sides. The Cretaceous is in the form of a long synclinal trough, compressed and overturned to the northeastward. Looking southeastward from this point down the valley, a section of the overturned rocks is seen in the distant hills.

251. Between Duthil and Banff, near the railway and to the north about two miles from Banff, openings have been made on anthracite coal-seams in the metamorphosed Cretaceous. Seams three to five feet. Coal of excellent quality.

252. Silver City. Castle Mountain, a remarkably bold range of Devono-Carboniferous limestone, nearly horizontal, rises immediately behind this place. Numerous discoveries of copper-ore in the vicinity.

253. Eldon. A few miles beyond Silver City the valley again turns to the northwest, following axis of anticlinal, which brings up Cambrian slates and quartzites. Mountains on both sides of valley still continue for the most part limestone.

254. Laggan. Remarkably picturesque lake, with glacier at head a few miles to the south.

255. Stephen. Near summit, between headwaters of Saskatchewan and Columbia Rivers, the general structure of the watershed range is synclinal, but complicated by minor flexures. Cambrian rocks appear a few miles down valleys both east and west of the summit. Grand peaks to north and south of valley of pass, in several cases exceeding 11,000 feet altitude. This is the only railway in North America from which actual glaciers of almost Alpine magnitude may be seen. Observe snow-field and glacier in first valley from north, west of Stephen.

256. Stonewall. Excellent exposures, in quarries, of Silurian limestones, in some beds highly fossiliferous.

257. Stone Fort. Quarries near Stone Fort and St. Andrews. Fossils.

Canadian Pacific Railway—Con.		Manitoba S. W. Colonization Railway—	
Ms.	Pembina Mountain Section.	Ms.	Continued.
0	Winnipeg. ²⁵⁹	20.	Alluvium. ⁷³⁷
4	St. James.		"
18	Sa Salle.		"
30	Osborne.		"
43	Morris.		"
58	Rosenfeld. ²⁵⁸		"
70	Gretna.		"
66	Plum Coulee.		"
81	Morden.		"
88	Thornhill.		"
96	Darlingford.		Pierre Shales.
102	Manitou.		"
Manitoba S. W. Colonization Railway.		Stonewall Section.	
0	Winnipeg.	20.	Alluvium.
7	Murray Park.		"
		13	Stony Mountain.
		20	Stonewall. ²⁵⁶
		4 c.	Hudson River.
		West Selkirk Branch.	
		0	Winnipeg.
		20.	Alluvium.
		Stone Fort. ²⁵⁷	4 b. Galena Limestone.
		22	W. Selkirk.

258. Rosenfeld. Copious flow of brine struck here in deep boring in Silurian.

259. Parkbeg. The so-called Continental moraine is represented in Dakota and the North-West Territory of Canada by the Missouri Coteau. It would appear that this and the so-called Coteau des Prairies in Minnesota and Dakota are parts of the same great feature. Their elevation is similar, and they are equally characterized by the immense profusion of erratics with which they are strewn, and by basin-like swamps and lakes. In southwestern Minnesota and eastern Dakota this elevated tract, according to Winchell, called by the earliest French explorers Coteau des Prairies, meaning highlands of the prairies, is 500 to 1,000 feet above the Minnesota River, and 1,300 to 2,000 feet above the sea. In the Coteau, then, viewed as a whole, we have a natural feature of the first magnitude, a mass of glacial debris and traveled blocks, with an average breadth of perhaps thirty or forty miles, and extending diagonally across the central region of the continent, from the southeastern corner of Minnesota far into northern Canada, a distance of about 800 miles. Dr. George M. Dawson, from whose writings this note is compiled, was the first to recognize the glacial origin of the Missouri Coteau. He pronounces it one of the most remarkable features of the Western plains in their northwestern extension, and as certainly the most important monument of the glacial period existing there. As to its origin, while he believes that the Coteau may possibly represent a Continental moraine, his examination of it led him to consider it as more probably due to a deposit of material from floating ice along the sloping front of the third prairie steppe. It is a question which should not be prejudged, as so many difficulties remain to be elucidated, from whatever stand-point it may be regarded. As to the similar deposit farther south in Minnesota and Dakota, etc., T. C. Chamberlin and other geologists, who have critically studied it, are quite decided in their belief that it is a terminal moraine. The superficial deposits are to be, for geologists, the great subject of the future.

J. M.

IV. British Columbia.

List of Formations.

COAST REGION.			INTERIOR REGION.
19. QUATERNARY.	Recent Raised Beaches. Stratified Sands, Gravels, and Clays (Marine Shells). Boulder Clay or Till.		Stratified Sands and Gravels, "White Silts" of Nechacco Basin, etc. Terrace Deposits, Moraines, Boulder Clay or Till.
20. TERTIARY.	Miocene (Volcanic). Miocene (Sedimentary, generally with Marine Shells).		Miocene (Volcanic). Miocene (Sedimentary with Lignites).
18. CRETACEOUS.	NANAIMO BASIN.		Nechacco Series. Skeena R. Sandstones with Coal. Itasyouco Beds 10,000'; Skeena Volcanic Series; Porphyrite Series (?). Aucella Beds of Tatlayoco, Jackass Mt., and Skagit 7,000' or more; Porphyrite Series (?).
	Tejon (of Cal.).	COMOX BASIN. Sandst. 8,294'. Up. Cong. 820' Up. Shales 770' Mid. Cong. 1,100' Mid. Shales 70' L. Cong. 900' L. Shales 1,000' Coal Meas. 739'	
	Chico (of Cal.).	1,320' Productive	
	QUEEN CHAR- LOTTE ISLANDS.		
	A. Up. Shales & Sandst. 1,500' B. Conglomer- ates 2,000' C. L. Shales & Sandst. 5,000' D. Agglomer- ate 8,500' E. L. Sand- stones 1,000'		
Shasta (of Cal.).	Aucella Beds of Quatsino Id.		
COAST REGION.			INTERIOR REGION.
16. TRIASSIC.	Monotis Beds and Contemporaneous Volcanic Rocks of Queen Charlotte and Northern Vancouver Islands. Volcanic Rocks of Sooke R. (?)		Monotis Beds of Northern Rocky Mts.; Red Beds of Southern Rocky Mts.; Nicola Series (Volcanic) of S. Interior Plateau. Auriferous Schists (in part?).
14. CARBONIFEROUS (possibly in part Devonian).	Crystalline and Metamorphic Rocks of Vancouver and Coast Range (largely altered Volcanic, but include Limestones, etc.).		Cache Creek Series. (Fusuline Limestone, Quartz- ites, Volcanic Materials, etc.)
9-12. DEVONIAN.			Limestones of Rocky Mts.
2-4. CAMBRIAN.			Basal Series of South. Rocky Mts.; also largely in Purcell and Selkirk's Ranges (Auriferous Schists in part?).
1. ARCHEAN.	Basal Rocks of Coast Range (?).		Gneissic Rocks and Crystalline Schists of Shuswap and Okanagan Lakes and Gold Range.

series, which have been characterized in a previous note: the greater part of the lake is, however, bordered by volcanic rocks of Tertiary age. Cherry and Battle Bluffs, on opposite sides of the lakes, are believed to represent the core of an ancient Tertiary volcano. In the former considerable veins of magnetite occur. Remunerative gold placers have been worked for many years on the Tranquille River, which flows into the lake. Near the town of Kamloops the rocks of the Cache Creek series reappear and characterize the banks of the South Thompson River to the lower end of Little Shuswap Lake, though the higher portion of the plateau to the south is composed of volcanic Tertiary rocks. White silty deposits, due to the last stage of the glacial period, are cut into terraces along the banks of the river. Little and Great Shuswap Lakes, with Adam's Lake, are fjord-like bodies of water occupying deep, mountain-bordered valleys in the western portion of the Gold Range. The lakes are bordered by gneissic rocks and crystalline schists, which have been referred to collectively, in the reports of the Geological Survey, as the *Shuswap series*, and are now believed to be Archaean. These rocks probably exceed thirty-two thousand feet in thickness, and are divisible into several subordinate series. For further information on the country from the mouth of the Fraser to this point, see "Descriptive Sketch of Physical Geography, and Geology of Canada, 1884," and "Report of Progress, 1877-1878." Leaving Shuswap Lake, the line follows up the valley of Eagle Creek and traverses the Gold Range by the Eagle Pass to the west crossing of the Columbia River. Thence it crosses the Selkirk range to the east crossing of the Columbia, and follows that river up (southward) to the mouth of the Kicking Horse. This portion of British Columbia may be said to be geologically unknown, but consists, so far as ascertained, of rocks similar to those of the Shuswap Lakes, with quartzites and schists which are probably Cambrian.

V. Steamboat Routes.

I. Montreal to Quebec. Little of geological interest is to be seen on this route, the river banks being generally low, or where higher usually showing only drift deposits. Near Quebec, sections of Cambrian and Cambro-Silurian rocks.

Quebec and Gulf Ports. Quebec to Pictou, Nova Scotia, with calls at intermediate ports. A picturesque and geologically interesting route.

Quebec. (See Note 24, under Intercolonial Railway.) Soon after leaving Quebec, a fine distant view of the Montmorenci Falls. Beyond the east end of the Island of Orleans, Laurentian rocks form the north shore. At St. Paul's Bay, Little Mal Bay, and Murray Bay, small outliers of Cambro-Silurian. Beyond these the north shore is entirely Laurentian. Behind Murray Bay the mountains are particularly bold. The south shore to beyond St. Anne des Monts is composed of Cambrian rocks, which form picturesque hills near Bic.

Father Point. Pilot station. Cambrian.

Metis. Cambrian. A sea-side resort.

Beyond Matane the Shickshock Mountains to the south. The higher portions composed of Pre-Cambrian rocks with extensive granitic intrusions. Beyond St. Anne des Monts the south shore is fringed with Cambro-Silurian rocks to Gaspé Bay.

Gaspé. Ship Head, at northern entrance to Gaspé Bay, a bold promontory. Lower Helderberg limestone. The shores of Gaspé Bay are generally characterized by Devonian rocks. Excellent sections. Fossil plants. The south point of Gaspé Bay is composed of rocks of the Bonaventure (Lower Carboniferous) series. This occupies the coast to the Bale des Chaleurs.

Percé. Silurian limestones here appear below the Bonaventure, and form the remarkable pinnated rock, two hundred and ninety feet high, which gives the place its name.

Bale des Chaleurs. (See notes under Intercolonial Railway.) The northern shore of the eastern part is principally composed of Silurian and Bonaventure rocks; the southern, at Bathurst, Bonaventure formation; eastward, to Point Miscou, Middle Carboniferous.

Miramichi Bay. Shores all Middle Carboniferous. Carboniferous rocks constitute the whole New Brunswick shore to Pictou. Prince Edward Island, Permo-Carboniferous and Triassic.

Quebec to Saguenay River.

Quebec. (See notes under Intercolonial Railway and Quebec and Gulf Port steamers.)

Murray Bay. An outlier of Cambro-Silurian rocks here occupies the coast for a distance of six miles, and runs up the Murray River for a similar distance, gradually narrowing out. The rocks are well displayed in White Point at the wharf and at Les Ecorchés on the east side of the bay. They consist of limestones and calcareous sandstones, Black River, and Trenton, and are highly fossiliferous in some places. Fossiliferous glacial clays on some parts of the beach at low tide. Ancient terraces with marine shells to height of over 600 feet in this vicinity.

Rivière du Loup. Cambrian. Marine shells in glacial clays of beach on east side of bay at mouth of river.

Tadousac. At mouth of Saguenay River. Laurentian. Fine examples of terraces at several levels. The Saguenay River, from this point to Ha Ha Bay, is the finest example of a fjord on the eastern coast of North America, and is celebrated for its grand and gloomy scenery. It possesses all the characters of a true fjord—bold rocky shores without beaches, uniformity in width, great depth in its upper part, and comparatively shallow water at its mouth. From Tadousac to Ha Ha Bay is a distance of about sixty miles. Near this point the valley bifurcates, one branch reaching to Lake St. John—forty miles—by Chicoutimi, while the other is occupied in part by Lake Kenogami. The rocks to Ha Ha Bay and Chicoutimi are all Laurentian, and generally heavily glaciated. Near the wharf at Ha Ha Bay an intrusive mass characterized by anorthosite felspar. Round Lake St. John extensive area of Norian rocks, with overlying Cambro-Silurian, and glacial clays with marine shells. The existence of this great fjord is probably due to the greater drainage area tributary to it as compared with other rivers on the north shore, and it was probably in the first instance excavated by the river at a period of greater continental elevation than the present.

Port Mulgrave to Sydney, C. B. (Steamers connecting with Eastern Extension Railway at Port Mulgrave and running through the Bras d'Or Lakes to Sydney, C. B.)

Port Mulgrave. (See Notes 65 and 66, under Eastern Extension Railway.)

The Bras d'Or Lakes are celebrated for their picturesque scenery. They are almost altogether surrounded by a fringe, of varying width, of Lower Carboniferous rocks, behind which rise hills of Pre-Cambrian rocks. The formations met with in Cape Breton generally are, however, very varied.

Sydney. Coal-formation rocks, with the most important coal deposits of Cape Breton. The principal workings are in the Sydney main seam, averaging about six feet thick, and these already extend in some places to a considerable distance beneath the sea. Fine section on northwest side of Sydney Harbor, described by Mr. Brown as including thirty-four seams of coal and forty-one underclays with *Stigmaria*. Erect trees and *Calamites* at eighteen distinct levels. Sydney mines afford good coal for gas-making and steam purposes, yielding a strong coke.

II. Toronto or Kingston to Montreal by Steamer. This is a favorite route with tourists. After leaving Toronto, the north shore of Lake Ontario is composed of Hudson River rocks for twenty miles. Thence Utica twenty miles, Trenton one hundred miles. The rocks are generally heavily covered with drift, which often forms steep banks. Both shores, and the islands at the eastern extremity of the lake, are based on Black River limestones. The north shore is then occupied by Laurentian for about thirty miles, the river cutting through a narrow neck of these rocks, which connects the great Laurentian area to the north with that occurring in New York State. This produces the well-known scenery of the Thousand Islands. For ten miles above Brockville the rocks on the north shore, Potsdam; south shore, Laurentian and Potsdam. Thence Calciferous on both shores twenty-five miles. Thence to Mill Roches (twenty-seven miles), north shore, Chazy; south shore, Calciferous. Thence Calciferous on both shores, twenty-four miles. Thence to Coteau (fifteen miles), north shore, Chazy; south shore, Calciferous. Thence, for eight miles, both shores and Grand Island, Calciferous. Thence, in twenty-six miles, Potsdam, Calciferous, Black River, Trenton, Utica, in regular succession to Montreal. (See notes on Grand Trunk Railway, which runs parallel to north shore of lake and river.)

THE RAPIDS OF THE ST. LAWRENCE.—Throughout that portion of the river characterized by rapids, the rocks are those of the Cambro-Silurian system. The Lachine Rapids occur over the outcrop of the Trenton limestone, the wide basin occupied by the river below being excavated in the softer Utica shales. With this exception, no very marked connection between the geological structure and the existence of the rapids is evident. The rapids may be said to begin below Prescott, but are unimportant till the Upper Long Sault is reached thirty miles below that place. Four and a half miles below these are the Longue Sault Rapids, which are twelve miles in length, with a fall of forty-eight feet. Farther down, at Otéau, the rapids recommence, and are known as the Côtéau Rapids. Below these is calm water for about five miles, when the Cedar Rapids, a mile and a half long, occur. After three miles of calm water are the Cascade Rapids, below which Lake St. Louis, at the mouth of the Ottawa River, is entered. The Lachine Rapids, between this lake and Montreal, are the last, with a descent of forty-five feet. Above the Lachine Rapids the descent of the river is one hundred and seventy-five feet, making the total descent, from Lake Ontario to the head of ocean navigation in the harbor of Montreal, two hundred and twenty feet. The average fall of the river is about eighteen inches to the mile, but a large part of this descent is accomplished in the various rapids. These are surmounted by vessels ascending the river by a series of canals, aggregating forty-two miles in length.

III. Routes from Sarnia, Owen Sound, Collingwood, etc., to Port Arthur (connecting there with C. P. Railway).

Two main routes are followed—one to the south of Manitoulin Islands to Saint St. Marie, the other to the north of the islands to the same point. The boats leaving the last-mentioned ports frequently take the north shore route, which, from a geological or picturesque point of view, is to be preferred.

The south shore of the Manitoulin Islands is throughout composed of Niagara limestones, with outlying patches of Guelph in some places.

After clearing Notawasaga Bay, the northeast shore of Georgian Bay is Laurentian to and at Killarney. Thence the shore of the mainland is for seventy-five miles Huronian, the off-lying islands consisting of Cambro-Silurian rocks, from the Black River series to the Niagara. The north shore is then for twenty miles Laurentian, this formation forming a narrow band with Huronian behind. Then twenty miles Huronian to Bruce Mines.

Bruce Mines. Good locality for studying the Huronian rocks. Copper-mines at one time extensively worked; at present closed. The veins traverse a mass of interstratified diorite. The ore is chiefly copper pyrites. From Bruce Mines for ten miles, north shore, Huronian; south shore, Cambro-Silurian. Thence to Lake Superior, both Sugar Island and the southwest main shore of peculiar red and spotted sandstone of Potsdam or Chazy age. Thence to Port Arthur steamers generally run far from land. The north shore is principally Laurentian and Huronian to Nipigon Bay, whence Lower Cambrian rocks characterize the shore and form all the off-lying islands to Thunder Bay.

Thunder Bay. (See Note 224, under C. P. Railway.)

IV. Victoria to Nanaimo and Comox and Northward.

Victoria. Highly altered rocks dioritic, felspathic, and micaceous, in a few places becoming almost gneissic, with interbedded black argillites and crystalline limestones. The latter in a few places hold obscure fossils, which are Paleozoic and very probably Carboniferous. Many intrusive syenitic, etc., masses; one of which characterizes both sides of Victoria Harbor at the entrance. The rocks of this vicinity may be taken as typical of those forming the axial portions of Vancouver Island, and are largely altered volcanic products. Limestone may be observed near entrance to Beacon Hill Park, and at the shore at the west end of the town. Fossils in limestone on road near east side of Esquimalt Bay. Very fine glaciated rocks everywhere along the shore. These are overlain by boulder-clay, and this again by stratified clays and sands which in some places yield marine shells. Good sections of all these deposits in shore cliffs. (See papers in "Quart. Jour. Geol. Soc.," Vol. XXXIV., p. 89, and *ibid.*, 1881.)

From Victoria, northward along coast, similar rocks to Saanich Point, the end of which is fringed by Cretaceous.

Cowichan Harbor. South side, Cretaceous. North side, metamorphic rocks (Carboniferous?).

Maple Bay. South side, Cretaceous; north side and at wharf, similar metamorphic rocks. From Maple Bay, for eight miles, coast metamorphic, off-lying islands Cretaceous. Thence to Dodd Narrows, coast and inland Cretaceous. (Productive coal measures.) Just north of Dodd Narrows, high cliffs of these rocks.

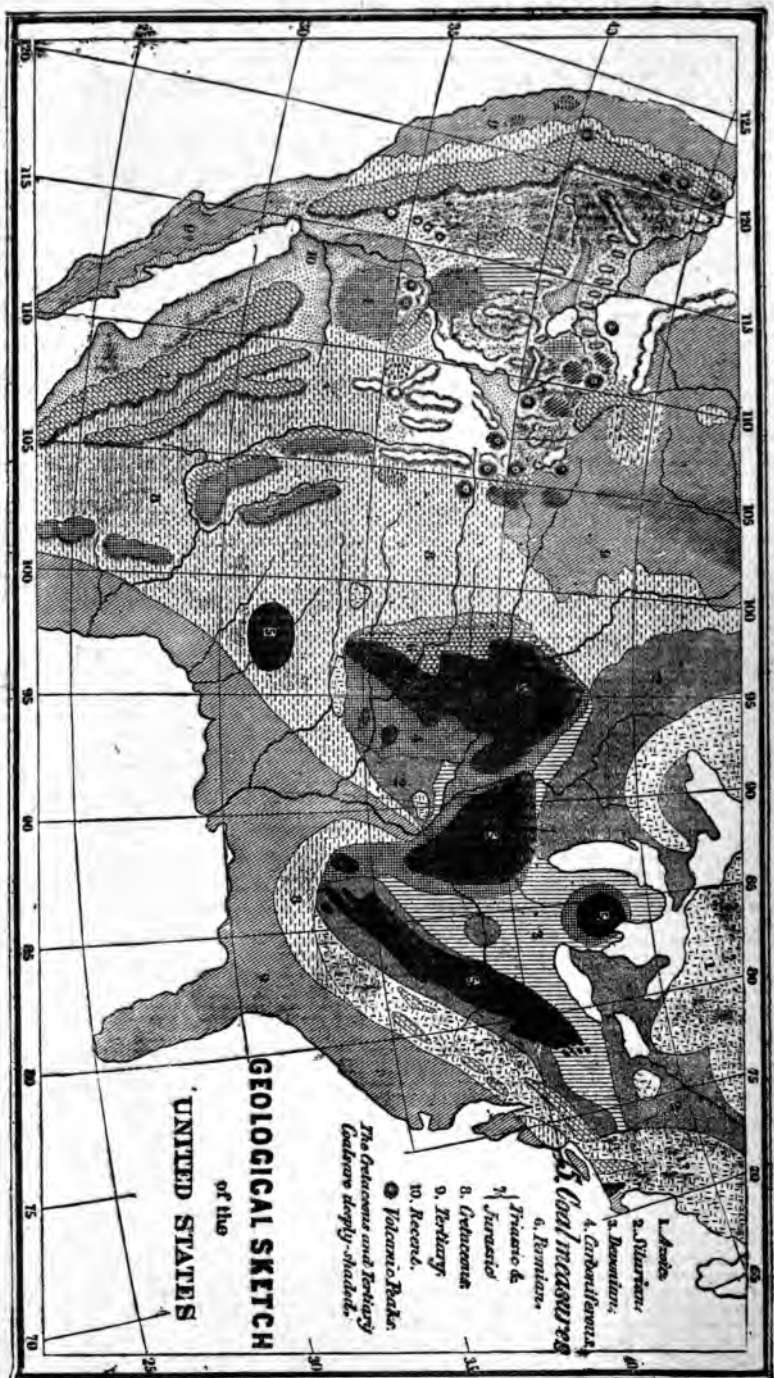
Nanaimo and Departure Bay. Productive coal measures (Cretaceous). Extensive coal-mines. Seams worked five to fifteen feet. These are true bituminous coals, yielding a good coke, and suitable for gas manufacture. From Departure Bay, for fourteen miles, the coast chiefly of metamorphic rocks like those above described. Thence to Comox, forty-two miles, Cretaceous.

Comox. An extensive coal-field, but by reason of the more accessible position of Nanaimo the mines here are not at present worked. On Texada Island, to the northeast, fine deposit of magnetic iron-ore.

N. B.—The route above described is that taken by coasting steamers. Steamers bound northward to Port Simpson and Alaska generally pass farther out near the off-lying islands. These are almost altogether composed of Cretaceous rocks, and, in consequence of their general northeastward dip, the outer tier of islands displays the higher members of the formation as here developed. The southwestern sides of the islands generally form low sandstone cliffs.

Route Northward from aboast Comox to Port Simpson and Alaska. From Comox the Cretaceous rocks probably extend in a wide belt along the shore nearly to Seymour Narrows, but are heavily covered by drift deposits, which form white cliffs. High mountains in the interior of Vancouver Island composed, so far as known, of crystalline rocks, with extensive granite intrusions.

Seymour Narrows and northward to Alert Bay. Metamorphic and crystalline rocks. (See Note 202, Can. Pacific Railway, W. Coast portion.) Near Port McNell, Cretaceous rocks again form a strip of low country extending back from the shore, and continue to Beaver Harbor. Thomas Point and north shore of Beaver Harbor, and thence to north end of Vancouver Island, all rocks of the older series. Similar metamorphic and crystalline rocks, with interbedded slaty argillites and limestones, and granitic intrusions northward to Wrangel, in Alaska. In vicinity of Port Simpson, slaty argillites and mica schists with limestones extensively developed. Near Wrangel similar mica schists yield very fine garnet crystals. Wrangel is at the mouth of the Stickeen River, by which the gold-mines of Cassiar are reached.



The New England States.

GENERAL NOTE ON THE GEOLOGY OF NEW ENGLAND.

THE geology of the New England States is much more difficult than that of the country west of the Hudson River and Lake Champlain. The rocks are very largely crystalline, besides being greatly contorted and folded. Both Archean and metamorphic Paleozoic groups are represented, and geologists have disagreed as to the extent occupied by each of these two series. A quarter of a century since (before 1886) the opinion was commonly entertained that these crystallines consisted entirely of Paleozoic rocks in an altered condition; now it is generally conceded that many of the older areas are to be found. Different views are also entertained as to the value of lithological distinctions for chronological purposes. Fortunately, a few fossiliferous areas have escaped the ravages of upheaval and denudation, and it is only by a study of the relations of these to the underlying or overlying crystallines, that any attempt at correlation is possible. The principal localities where fossils are found are (1) the region of the Taconic schists and Stockbridge limestones; (2) that of probably Devonian limestone in the Connecticut Valley at Bernardston; and Niagara limestones at Littleton, N. H.; and (3) that of carboniferous rocks in Rhode Island and their continuation northeastward into Massachusetts. Devonian fossils have been found in the northern part of Maine, and Silurian and Devonian in the eastern part of Maine. The 16. Triassic of Connecticut Valley need not be named as one of these doubtful areas.

The scheme of classification proposed by Professor C. H. Hitchcock for the whole of New England is printed on an introductory page, while his determinations as to the formation at each railroad station are those given in this "Guide" for Maine, New Hampshire, Vermont, and Connecticut. In the chapter on Massachusetts, the determinations for each railway station are given by Professor W. O. Crosby, representing a class of geologists holding widely different views, who recognize the Taconic system and believe that the white crystalline marble, 3,000 feet thick, in Berkshire County, Mass., lies below the Cambrian, and is a distinct and much older formation; and claim that the fossils referred to occur in outliers of the newer, resting on these older formations, just as they often do elsewhere. They also claim that the highly crystalline Taconic schists can not be correlated successfully with the Cambrian or with the Hudson River group.

The following scheme of classification of the New England crystallines, by Professor Hitchcock, is also very different from that given by Professor W. O. Crosby for Massachusetts. The differences are occasioned chiefly by the views entertained concerning the igneous rocks, syenites, granite, and porphyry. In Dr. Hitchcock's scheme these are regarded as of later origin than the gneisses, which have been disturbed by their eruption; but Professor Crosby seems to regard many of the syenites, felsites, and diorites as older than the gneisses; because the latter appear to rest or lean upon the unstratified rocks. The difference is so radical that the schemes can not be harmonized. But, in a work of this character, it is right that the different views should be represented.

Professor Hitchcock also thinks that the word Montalban is misleading, and, as restricted by him in New Hampshire, it would not embrace over one sixth part of the rocks so named by Professor Crosby. The typical area of Montalban in the White Mountains is said by the former to be either overlaid or cut by the rock called Norian by Dr. T. Sterry Hunt and Professor Crosby. Hence, it is claimed, the Norian is the newer of the two, and the scheme proposed for Massachusetts is by him considered erroneous.

However the reader may differ with either party, he will find much positive knowledge which all will accept in these pages, where the kinds of rock along the railroads are given, i. e., gneiss, mica schists, granite, etc., and we can leave it to time to give to these formations of doubtful age their true place in the series, for it is believed that the discovery of fossils here and there about New England may, after a while, settle the geology of a large portion of that difficult country, and that even an accepted classification of the crystalline rocks may be accomplished.

J. M.

Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

Table of the Geological Formations of the New England States.

By PROFESSOR C. H. HITCHCOCK.

Cenozoic.		Foliated Crystalline Series— <i>Con.</i>	
20. Quaternary.	20 c. Terraces.	D. Huronian.	Hydromica (talcoose) Schists and Grits.
"	20 b. Champlain Clays.	Subdivided	Volcanic Group of Selwyn
"	20 a. Till, drumlins, Terminal Moraine.	in Connecticut	Hornblende Schist.
19. Tertiary.	19 c. Pliocene.	Valley into	Merrimack Group and
"	19 b. Miocene.	Auriferous	Schists.
"	19 a. Eocene.	conglomerate, Lyman and Lisbon groups	Rockingham Group (in part).
Mesozoic.			Ferruginous Slates (N. H.)
16. Triassic.	16. Triassic.	C. Upper	Montalban.
Paleozoic.		Laurentian	Green Mountain Gneiss.
14. Carbonifer's.	14 b. Coal Measures.	B. Middle	Lake Winnipiseogee Gneiss.
"	14 a. Lower Carboniferous.	Laurentian	Bethlehem Gneiss.
8-10. Devonian.	{ 10 s. s. Probably Hamil- ton. Slates of St. Croix River.	A. Lower	Porphyritic Gneiss.
"	9. Upper Helderberg l. s.	Laurentian	Adirondack Gneiss.
"	8. Oriskany Group.		K. 2. and K. 3. of Conn.
5-7. Silurian.	7. Lower Helderberg.	Eruptive Crystalline Rocks.	
"	5. Niagara.	BASIC.	Mesozoic Diabase or Dolerite.
3-4. Cambro- Silurian.	4 d. Magnesian Slate (Em- mons), possibly Cam- brian.		Older Diabase.
"	4 c. Lorraine Shales.		Diorite.
"	4 b. Utica Slate.		Melaphyr.
"	4 a. Trenton Limestone.	ACIDIC.	Gabbro.
"	Black River and Birdseye l. s.		Felsite.
"	3 c. Chazy l. s.		Porphyry.
"	3 b. Levis Limestone.		Granite.
"	3 a. Calciferous Sandrock.		Syenite.
2. Cambrian.	{ 2 b. Potsdam ss. sl. qu. Georgia Group, Clay Slate.		Protogene.
"	2 a. Acadian. Clay Slates unfossiliferous. Taconic Slate (in part).	Cambrian and Cambro-Silurian Rocks of the Champlain Valley, with their thickness in feet.	
Foliated Crystalline Series.		4 c. Lorraine Slate.....	400
E. Groups of debatable age, probably pre- Cambrian.		Hydromica Schist, Taconic Range....	2,000
Rockingham Group, Slates and Quartzites.		4 b. Utica Slate.....	300
Coös Group. { Calciferous Mica Schist.		4 a. Trenton Limestone.....	400-600
Quartzites.		Black River, or La Motte and Birds- eye Limestone.....	40
Kearsarge Group.		3 c. Chazy Limestone.....	400
		3 b. Levis Limestone.....	600
		3 a. Upper Calciferous Sandrock....	200
		Lower " " " " " "	400
		Fucoidal Layer.....	200
		Potsdam Sandstone, red.....	500
		" " gray.....	310
		" quartzite.....	1,200
		Georgia Slates.....	3,000
		Cambrian Slates and Schists.....	4,000
		Total thickness.....	14,150

Eruptive Crystalline Rocks of New Hampshire, with local names.

BASIC.	Mica Diabase.	ACIDIC.	Felsite.
	Porphyritic Diabase.		Porphyry.
	Anorthite Diabase.		Quartz Porphyry.
	Olivine Diabase.		Orthoclase Porphyry.
	Ordinary Diorite.		Pequawket Breccia.
	Porphyritic Diorite.		Muscovite Granite.
	Mica Diorite.		Muscovite Biotite or Concord Gr.
	Labradorite Diorite.		Franconia Breccia Granite.
	Gabbro.		Biotite or Conway Granite.
			Mica Hornblende or Chocorus Gr.
			Hornblende or Albany Granite.
			Protogene.
			Granitell.
			Granite of Veins.
			Augite Syenite.
			Hornblende Syenite.

Maine.¹

Ms.	Maine Central Railroad.		Ms.	Lewiston Division.			
0	Portland.	D. Huronian.	13	0	Portland.	D. Huronian.	13
8	Falmouth.	B. Laurentian.	49	8	Falmouth.	B. Laurentian.	49
15	Yarmouth.	"	88	19	Gray.	"	106
20	Freeport.	"	127	29	Danville Junc'n.	C. Montalban.	200
25	Oak Hill.	"	125	36	Lewiston.	"	200
29	Brunswick.	"	64	46	Leeds Junction.	"	271
37	Bowdoinham.	"	10	55	Winthrop.	"	220
44	Richmond.	"	77	61	Readfield.	"	
56	Gardner.	"	23	74	North Belgrade.	"	
60	Hallowell.	Granite.	54	84	Waterville.	2. Cambrian.	117
62	Augusta.	"	48				
70	Riverside.	2. Cambrian.					
81	Waterville.	"	117				
89	Clinton.	D. Huronian.	133				
94	Burnham.	"	157				
101	Pittsfield.	"	210				
108	Newport.	"	200				
117	Etna.	"					
125	Herman Pond.	"					
135	Bangor.	"	13				
Skowhegan Division.			Belfast Division.				
0	Waterville.	2. Cambrian.	117	0	Burnham.	D. Huronian.	157
11	Pishon Ferry.	D. Huronian.		8	Unity.	"	223
19	Skowhegan.	"		12	Thorndike.	"	267
				22	Brooks.	B. Laurentian.	376
				32	City Point.	E. Pre-Cambrian.	29
				34	Belfast.	"	29
			Dexter Division.				
0	Newport.	D. Huronian.		0	Newport.	D. Huronian.	
7	Corinna.	"		7	Corinna.	"	
14	Dexter.	"		14	Dexter.	"	

1. The eruptive rocks of Maine have not been studied yet. The "traps" along the sea-shore are of at least four different ages. The oldest is porphyritic; the second metalliferous; the third was ejected earlier than the Devonian; while the fourth has cut Hamilton sandstones. In the northern part of the State is a trappean conglomerate, with pebbles more than a yard in diameter. A light-colored, coarse diorite forms a mountain mass in Rangely, and the same material is commingled with serpentine farther north, nearer the Canada line. The granites and syenites are as varied as those of New Hampshire. The granite of Biddeford is the same as the Conway granite of New Hampshire, but with fewer cavities to produce disintegration. A drab-colored porphyry occurs in mountain masses upon Moosehead Lake and near Mount Katahdin. Siliceous slates and jaspers abound on the coast of Washington County.

The Lower Helderberg is also cut by trap dikes in several localities.

Maine Central Railroad—Con.			Ma. | Knex and Lincoln Railroad.	
Androscoggin Division.				
0 Bath.	B. Laurentian.		0 Bath.	B. Laurentian.
9 Brunswick.	"	64	11 Wiscasset.	"
20 Lisbon.	C. Montalban.		18 New Castle.	"
27 Lewiston.	"	200	30 Waterloo.	"
34 Leeds Junction.	"	271	37 Warren.	"
44 North Leeds.	"	280	45 Thomaston. ³	{ 3-4. Limestone. Cam- bro-Silurian. " and Quartzite.
54 Livermore Falls.	D. Huronian.		49 Rockland.	
67 Wilton.	B. Lake Gneiss.		Bangor and Piscataquis Railroad.	
74 Farmington.	E. Pre-Cambrian.		0 Bangor.	D. Huronian.
Bangor to Vanceboro.			12 Old Town. ⁴	"
0 Bangor.	D. Huronian.	11	21 Alton.	"
4 Veazie.	"	110	31 Lagrange.	"
7 Buson Mills.	"	56	40 Milo.	"
9 Orono.	"		53 Dover.	"
10 Webster.	"		61 Guilford.	2. Cambrian.
12 Great Works.	"		64 Abbot.	"
13 Old Town. ⁴	"	88	65 Blanchard.	"
14 Milford.	"		81 Shirley.	"
19 Costigan.	"	111	88 Greenville and } Moosehead.	"
23 Greenbush.	"		Portland and Rochester Railroad.	
27 Olamon.	"	131	0 Portland, Me.	D. Huronian.
31 Passadumkeag.	"	131	3 Westbrook.	C. Montalban.
36 Enfield.	" and granite.	190	5 Cumberland Ma.	E. Pre-Cambrian.
45 Lincoln.	"	206	6 Saccarappa.	"
56 Winn.	"	201	10 Gorham.	"
58 Mattawamkeag.	"		15 Buxton Centre.	"
66 Kingman.	"	225	18 Saco River.	"
79 Bancroft.	"	323	21 Hollis Centre.	"
88 Danforth.	"	379	25 Cen. Waterboro.	"
93 Eaton.	"	400	28 S. Waterboro.	"
98 Forrest.	"	435	32 Alfred.	Syenite.
102 Toma.	"		36 Springvale.	C. Montalban.
114 Vanceboro. ⁵	3-4. Camb. Silurian.	394	43 E. Lebanon.	E. Kearsarge Group.
Bangor to Mt. Desert.			49 E. Rochest., N.H.	"
137 Bangor. ⁶	D. Huronian.	13	52 Rochester.	"
148 Holden.	Granite.		Somerset Railroad.	
164 Ellsworth Falls.	D. Huronian.		0 North Anson.	D. Huronian.
166 Ellsworth.	D. Huronian.		4 Anson.	"
176 Hancock.	"		12 Norridgewock.	"
179 { Mt. Desert } Ferry.	"		25 Oakland.	"

2. Livermore. Station at gorge in Pemigewasset River, and shows finely several dikes of igneous rocks of different ages. As carefully studied by Dr. Hawes, they are diabase, olivine diabase, diorite, syenite, and granite.

3. Thomaston. The location of the limestone-quarries furnishing the famous Rockland or Maine lime.

4. Oldtown. Most of the ancient valleys of New England have an escarpment or ridge of coarse gravel and sand following the channel of the current as the ice of the glacier period began to melt. These ridges are more common in Maine than elsewhere.

5. Vanceboro. The pale argillites along the St. Croix River, near and below Vanceboro, are called Devonian by Messrs. Bailey and Matthew, provincial geologists of New Brunswick, because of the discovery of the remains of *Lepidodendron* in it in the Maguadavic Valley.

6. Eastport. These same authors regard the red sandstones near Eastport as of Lower Carboniferous age, instead of the Hamilton Devonian, as they have been heretofore referred. St. Andrews, N. B., or Calais, Me., is the nearest railroad station to Eastport.

New Hampshire.'

Ms. | Grand Trunk Railway.			Ms. | Portland & Ogdensburg R. R.—Con.		
0	Portland, Me.	D. Huronian.	60	North Conway. ⁹	Conway Granite. 591
5	Falmouth.	B. Laurentian. 49	66	Glen Station.	Albany Granite. 590
11	Yarmouth.	" 94	72	Upper Bartlett.	Conway Granite. 660
18	Pownal.	C. Montalban. 143	78	Bemis.	C. Montalban. 996
27	Danville Junc'n.	" 200	87	Crawford's. ¹⁰	" 1903
36	Mechanic Falls.	" 298	91	Fabyan's.	" 1571
41	Oxford.	" 321	96	Twin Mount'n. ¹¹	B. Bethlehem Gr. 1376
47	South Paris. ⁸	B. Laurentian. 389	100	Bethlehem Junc.	" 1187
55	West Paris.	" 423	104	Wing Road.	A. Laurentian. 1019
65	Locke's Mills.	" 718	114	Lunenburg, Vt.	D. Huronian.
70	Bethel.	" 646	Boston and Lowell Railroad.		
80	Gilead.	C. Montalban. 711	0	Concord. ¹⁹	Concord Granite. 252
86	Shelburne, N.H.	" 704	10	Canterbury.	E. Rockingham Schist.
91	Gorham.	" 794	18	Tilton.	B. Lake Gneiss. 458
98	Berlin Falls.	B. Lake Group. 1016	27	Laconia.	C. Montalban.
103	Milan.	" 1060	33	Weirs. ¹⁴	A. Porphyritic Gneiss.
122	Groveton.	D. Huronian. 884	48	Ashland. ¹⁵	"
134	North Stratford.	" 902	51	Plymouth.	C. Montalban. 474
142	Wenlock.	Granite. 1162	59	Rumney.	" 590
149	Island Pond.	" 1197	67	Wentworth.	B. Lake Gneiss.
166	Norton Mills.	" 1367	71	Warren.	" 736
175	Coaticooke.	E. Calcife's Mica Schist.	84	Haverhill.	D. Huronian. 419
(Continued in Canada.)			98	Wells River.	" Lyman. 443
Portland and Ogdensburg Railroad.			108	Lisbon.	" Lisbon. 577
0	Portland, Me.	D. Huronian. 16	North Lisbon.		
5	Westbrook.	C. Montalban. 19	118	Littleton. ¹⁶	5. Niagara. 667
11	So. Windham.	"	120	Wing Road.	E. Coös and 8. Niag. 817
17	Sebago Lake.	" 274	124	Bethlehem.	A. Porphyritic Gn. 1019
24	Steep Falls.	" 305	129	Twin Mountain.	B. Bethlehem Gn. 1187
32	Baldwin.	"	134	Fabyan's.	" (Loc. Glacier) 1375
36	Hiram.	"	120	Wing Road.	C. Montalban. 1571
43	Brownfield.	" 396	128	Dalton.	A. Porphyritic Gn. 1019
49	Fryeburg.	" 420	135	Lancaster.	D. Huronian. 866
55	Conway C., N.H.	Conway Granite. 455	145	Groveton Junc.	" 870
					901

7. The New Hampshire formations are believed to possess thickness as follows: Niagara, 500 feet; Calciferous mica schists, 4,800 feet; Coös group, 7,300 feet; Cambrian slates of Connecticut Valley, 3,000 feet; Kearsarge group, 1,300 feet; Rockingham mica schists, 6,000 feet; Merrimack group, 4,300 feet; Huronian, 12,000 feet; Montalban, 10,000 feet; Lake Winnipiseogee gneiss, 18,000 feet; Bethlehem gneiss, 5,000 feet; porphyritic gneiss, 5,000 feet.

8. Paris. Locality of the famous red and green tourmaline. At least one hundred remarkably fine specimens of tourmaline have been taken from this vein and placed in museums or cut as gems. Forty varieties of mineral occur in a coarse granite, one of which is mica in large plates.

9. North Conway. Mount Kearsarge, in full view from the station, is a conical mass of Albany granite which has broken through both the Conway granite and a slate, and contains numerous fragments of both these rocks in its igneous embrace.

10. Crawford House. The railroad passes from here through the well-known notch of the White Mountains and around the base of Mount Willard, a region as famous for its varieties of granite as for scenery. The cut at the summit is through typical Montalban schists. Opposite Dismal Pool it is traversed by an enormous vein of fine-grained granite, which has also cemented together immense fragments of the Montalban schists. The junction between this Franconia breccia and the succeeding Conway granite, may be followed up a cliff for one thousand feet higher than the railroad, the latter rock having been erupted last. Between this Conway granite and a dark slate often filled with large pencils of andalusite is the interesting vein, three hundred feet wide, of Albany granite, which illustrates the action of a melted rock upon slates, giving rise to "contact phenomena." The slates have been rendered more crystalline; have been altered into hornstone; the broken pieces have been cemented by a siliceous paste full of microscopic tourmaline; and Carlsbad twin crystals of orthoclase, with dihedral pyramids of quartz, are developed in the lower part of the Albany granite. All these and other interesting phenomena may be seen along the railroad in a walk of half a mile.

11. Twin Mountain. The large boulders of granite east of the hotel are part of the moraine of a local glacier which has moved in a northwest direction. The boulders have certainly been transported from some ledge nearer Mount Washington than Fabyan's.

90 AN AMERICAN GEOLOGICAL RAILWAY GUIDE. (NEW ENGLAND.)

Boston and Lowell Railroad—Con.			Ms. | Concord and Claremont Division.—Con.		
Ms.	Concord to Nashua.				
0	Concord.	Concord Granite.	35	Bennington.	A. Laurentian.
5	Suncook.	C. Montalban.	281	37	Hancock Junct. "
9	Hooksett. ¹⁷	"	206	44	Peterboro. B. Lake Gneiss.
13	Martin's.	B. Lake Gneiss.	199	Nashua to Keene.	
18	Manchester. ¹⁸	"	181	0	Boston.
26	Reed's.	"	137	40	Nashua.
29	Thornton's.	"	125	45	S. Merrimack.
35	Nashua.	D. Merrimack Gr'up.	120	48	Amherst.
Suncook Valley Branch.			51	Milford.	B. Laurentian.
0	Hooksett. ¹⁷	C. Montalban.	206	55	East Wilton.
20	Pittsfield.	E. Rockingham Sch.	493	59	S. Lyndeboro.
Northern Division.			66	Greenfield.	C. Montalban.
0	Concord.	Concord Granite.	252	71	Hancock Junct'n.
7	Penacook.	C. Montalban.	268	75	Hancock.
14	Nor. Boscawen.	"	290	82	Harrisville.
17	Franklin.	"	263	89	Marlboro.
25	East Andover.	"	661	96	Keene.
31	Potter Place. ¹²	E. Kearsarge Gr.	653	Mt. Washington to Wing Road.	
44	Grafton. ¹³	A. Porphy. Gneiss.	848	0	Mt. Washington.
52	Canaan.	D. Hornblende Schist.	965	3	Base Mt. W'n. ²⁰
59	Enfield.	B. Bethlehem Gneiss.	768	9	Fabyan's.
65	Lebanon.	"	510	10	Wh. M't'n. House
69	W. R. Junction.	D. Hornblende Sch.	369	14	Twin Mt. H'se. ¹¹
Concord and Claremont Division.			19	Bethlehem Jun.	B. Bethlehem Gr.
0	Concord. ¹⁹		252	23	Wing Road.
8	Mast Yard.	D. Ferrug. Schista.	375	A. Laurentian.	
12	Contoocook.	Concord Granite.	373	Pemigewasset Valley Branch.	
18	Warner.	B. Lake Gneiss.	422	0	Plymouth.
23	Roby's Corners.	A. Porphyritic Gneiss.	679	2	Livermore F'ls. ²
27	Bradford.	"	1130	4	Campton.
34	Newbury.	"	892	7	Campton Vill.
48	Newport.	B. Lake Gneiss.	707	9	Thornton.
48	Kelleyville.	"	543	13	W. Thornton.
54	Claremont.	E. Calc. Mica Sch.	373	16	Woodstock.
12	Contoocook.	Concord Granite.	439	20	N. Woodstock.
20	Henniker.	A. Porphy. Gneiss.	574	Profile and Franconia Notch Railroad.	
27	Hillsboro.	B. Lake Gneiss.	1157	0	Bethlehem.
33	Antrim.	"	1937	10	Profile House.

12. Potter Place. Mount Kearsarge may be reached from this station, or from Warner upon the Concord and Claremont Railroad. The rock is an andalusite mica schist, the same with that of Mount Monadnock in Jaffrey and the base of Mt. Kearsarge near North Conway. (Please notice the spelling of *Ki* and *Kearsarge*.)

13. Grafton. Locality of the largest beryl known, weighing two and one half tons. This was formerly preserved beneath a rude shed built to protect the mineral, but the shed and crystal have now fallen into decay. Very large crystals of the same mineral are now found occasionally in one of the mica-quarries.

14. Weir's. About half a mile from the station is a thick bed of clay lying between the lower and upper till.

15. Ashland. Between Weir's and Ashland many excellent exposures of porphyritic or oldest gneiss may be seen along the railroad. Over twenty of these areas have been described in the State, and are supposed to represent the earliest known ejections of igneous matter, in which foliation has been superinduced in concentric layers resembling strata.

16. Littleton. The fossiliferous limestone, here first called Lower Helderberg, is regarded by Professor R. P. Whitfield as Niagara, because of the presence of the chain coral and of *Pentamerus nyctus*.

17. Hooksett. The railroad-bridge over the Merrimack River rests upon islands of a white quartz, which are the outcrops of a remarkable vein, traced for over 125 miles, from Royalston, Mass., to Bridgeton in Maine. A second vein, parallel to this, crosses the river just north of Manchester, ten miles distant.

18. Manchester. The prevailing rock is a coarse saccharoidal gneiss, believed to correspond very closely in lithological aspect with the typical Laurentian of New York and Canada.

19. Concord. The traveler will do well to visit the State-House, with its large relief map of the State, and the large quarries of Concord granite two miles toward West Concord.

Monadnock Railroad.		
0	Peterboro.	B. Lake Gneiss. 744
7	Jaffrey.	C. Montalban. 1032
11	Rindge.	" 1002
17	{ Winchen- don, Mass. }	Gneiss. 993

Concord and Portsmouth Railroad.

0	Manchester.	B. Lake Gneiss. 181
8	Auburn.	" 289
18	Raymond.	D. Huronian. 173
24	Epping.	E. Rockingham. 154
31	New Market.	Exeter Syenite. 52
41	Portsmouth.	E. Rockingham.

Manchester and Lawrence R. R.

0	Manchester.	B. Lake Gneiss. 181
8	Wilson's.	D. Merrimack Group.
14	Windham.	" 324
22	Messers.	" 65
26	Lawrence.	"

Manchester and North Weare Railroad.

0	Manchester.	B. Lake Gneiss. 181
11	Oil Mills.	" and A.
19	North Weare.	" 489

Cheshire Railroad.

0	Bellows Falls. ²⁴	C. Montalban. 305
4	Walpole.	E. Coos Sch. & Qu. 217
10	Westmoreland.	D. Hornblende Sch. 512
22	Keene.	B. Bethlehem Group. 466
32	Troy.	C. Montalban. 1002
37	Fitzwilliam.	Concord Granite. 1063
43	State Line.	C. Montalban. 898
46	Winchendon.	" 448
54	S. Ashburnham.	" 1014
64	Fitchburg.	" 430

Ashuelot Railroad.

0	Keene.	B. Bethlehem Group. 466
8	Westport.	"
15	Ashuelot.	A. Porphy. Gneiss. 434
24	South Vernon.	E. Coös Quartz.

Whitefield and Jefferson Railroad.

0	Whitefield Jun.	D. Huronian. 931
1	Whitefield Vill.	"
3	Hazen's Mills.	B. Laurentian.

Whitefield & Jefferson R. R.—Con.		
7	Cherry Pond.	B. Laurentian.
10	Jefferson.*	"

Montpelier and Wells River R. R., Vt.

0	Montpelier.	Clay Slate. 484
6	E. Montpelier.	E. Calcif's Mica Schist.
10	Plainfield.	" 752
15	Marshfield.	" 1140
21	Summit.	Granite.
28	Groton.	E. Calcif. Mica Sch. 773
34	Boltonville.	" 624
38	Wells River.	D. Huronian. 443

This railroad is in Vermont.

Saratoga and Champlain Railroad.

0	Rutland.	Calcif. Sandrock. 519
11	Castleton.	2. Cambrian Slates. 475
8	Granville, N. Y.	"
19	Rupert.	"
26	Salem.	"
34	Eagle Bridge.	"

Worcester, Nashua and Rochester R. R.

0	Worcester, Ms. ²²	Mica Schist. 473
9	W. Boylston.	" 442
10	Oakdale.	" 322
12	Sterling Junc'n.	" 438
17	Clinton.	E. Pre-Cambrian. 309
19	Lancaster.	" 259
25	Harvard.	" 228
28	Ayer Junction.	D. Merrimack Group. 230
32	Groton.	" 303
36	Pepperell.	" 205
40	Hollis, N. H.	" 195
46	Nashua.	" 120
49	Hudson.	"
52	W. Windham.	"
56	Windham.	" & B. Lau'n.
63	Hampstead.	" 258
65	Sandown.	"
70	Fremont.	"
74	Epping.	" 154
79	Lee.	"
88	Barrington.	" & B. Lau'n.
93	Gonic.	E. Kearsarge Group.
95	Rochester.	" 226

* Railroads not found under New Hampshire heading will be found in Massachusetts.

20. Mt. Washington. Boulders that have been transported as much as twelve miles, and up-hill nearly four thousand feet, by the ice sheet, occur upon the top of this mountain. Striae occur here and upon all the Presidential summits, running southeasterly.

22. Worcester. Mr. Joseph H. Perry announces the discovery of a *Lepidodendron* in the plum-bago of Worcester. Lesquereux, after examination of photographs, pronounces it to be like the *L. acuminatum* of the Carboniferous limestone of Siberia. If there is no mistake about this discovery, it will prove the existence of an outlier of the Lower Carboniferous in Central Massachusetts. The schists have been supposed by us to belong rather to the Huronian or Cambrian.

* Upon July 10, 1885, a new slide scarred the north side of Cherry Mountain. It originated in the giving way of a ledge near the top of the mountain, when the ground was exceedingly wet. The earth slid one and a half miles in about four minutes' time, killing cattle in the field and fatally wounding one man. The lower end is very near this station.

Vermont.²³

Central Vermont Railroad.			Central Division—Con.		
Ms.	Southern Division.		Ms.	Rutland Division.	
127	Brattleboro.	2. Cambrian. 228	292	Milton.	2 Potsdam Limes. 361
130	Putney.	E. Coös Schist. 267	296	Georgia. ³⁰	Potsdam Slate. 366
141	Westminster.	2. Cambrian. 264	306	St. Albans.	2 Potsdam Slate. 369
145	Bellows Falls. ²⁴	C. Montalban. 276			
153	Ch'rest'wn, N.H.	E. Coös Group. 276	0	Bellows Falls. ²⁴	C. Montalban. 288
168	Claremont, N.H.	E. Calcifer's Mica Schist. 231	5	Rockingham.	E. Calcifer's Mica Sch. 232
171	Windsor. ²⁵	" 231	10	Chester.	B. Lake Gneiss. 201
179	North Hartland.	2. Camb. & D. Huro'n. 287	22	Cavendish.	" 221
185	White River Jn.	D. Hornbl. Sch. 369	27	Ludlow. ²⁷	D. Huronian. 1061
Central Division.			34	Summit.	B. Green Mt. Gneiss. 1196
171	Hartford.	2. Cambrian. 486	39	E. Wallingford.	" 1196
198	Sharon.	E. Calcifer's Mica Sch. 607	46	E. Clarendon.	3 b. Camb. Sil. Limest. 2 a. Calcifer's Sandrock (Stockbridge). 219
205	Royalston.	" 617	52	Rutland. ²⁸	3 c. Chazy Marble. 233
216	Bethel.	D. Huro'an Soapst. 676	59	Sutherland Falls.	19 a. Eocene Tert'y. 261
217	Randolph.	" 698	69	Brandon.	3 c. Chazy Marble. 246
223	Braintree.	" 784	74	Leicester Junc.	" 241
232	Roxbury.	" Verde Ant. 1016	79	Salisbury.	3 b. Lewis Limest. 201
239	Northfield.	D. Huro'an Soapst. 739	85	Middlebury.	3 c. Chazy Limest. 291
249	Montpelier.	" & Clay Slate. 629	89	Brooksville.	4 a. Trenton Limest. 201
258	Waterbury.	" 434	98	New Haven.	3 c. Chazy Limest. 131
266	Bolton. ²⁶	B. Green Mt. Gneiss. 245	99	Vergennes.	" 161
272	Richmond.	D. Huronian. 228	104	Nor. Ferrisburg.	" 161
281	Essex Junc'n.	Clay Slate. 360	108	Charlotte. ²⁹	" 161
286	Winooski.	3 b. Camb. Sil. Limes. 190	113	Shelburne.	2 j. Potsdam Sand. 161
289	Burlington.	2 Potsdam Sandst. 109	120	Burlington.	" 109

23. LIST OF ERUPTIVE ROCKS OF VERMONT. — Diabase, diorite, trachytic porphyry, muscovite granite, mica hornblende granite, protogene, granitell, concretionary granite, granite of veins, syenite, brecciated syenite. The trachytic porphyry is supposed to have been erupted at the close of the Silurian.

24. Bellows Falls. The finest exhibition of terraces along the Connecticut River north of Massachusetts is just south of the village of Bellows Falls.

25. Windsor. An interesting escar has been traced from Lyme, N. H., to Windsor, Vt., about thirty miles long. Portions of it have been removed by the wearing action of the Connecticut. It appears to have been deposited by a powerful current derived from the melting of the glacial sheet prior to the accumulation of terraces. Mt. Ascutney, 3,186 feet high, is proved to be an eruptive mass of syenite and granite which has been protruded through a narrow orifice and poured out over a floor of the calciferous mica schist about one thousand feet above the sea, very much as lava accumulates around a volcanic vent. The melted material penetrated cracks in the underlying calciferous mica schist, forming veins indurating the clayey layers, calcining and glazing the limestones, but where it flowed over gneiss the floor remained unaffected. Many other granite mountains in Northern New England show similar proofs of protrusion at the surface.

26. The center of the anticlinal axis of the Green Mountains. At least eight of the general sections of the Vermont survey show this feature of structure, proving this formation to be older than the Huronian adjacent upon both sides. This structure was denied by Logan for the continuation of the Vermont rocks in Canada in his generalizations, but his descriptions of the rocks confirm the views of the Vermont geologist. Dr. Selwyn, the successor of Logan in office, accepts the Vermont view.

27. Ludlow. In Plymouth, ten miles north, gold is now (1885) being profitably milled from quartz. It is in the Huronian, which may be followed continuously to Zoar and Chester, Mass., upon the Fitchburg Railroad.

28. Rutland. The Rutland Railroad follows the Champlain Valley, noted for the presence of the entire series of Lower Silurian groups. The valley itself is a part of the great Appalachian Valley, extending from the St. Lawrence to Alabama, and constituting a natural and well-marked boundary between the crystalline groups on the east, known as the Green Mountains, Highlands of New York and New Jersey, Blue Ridge of Virginia, and the true Appalachian Mountains on the west from the Catskills to the Cumberland plateau, in Tennessee.

29. Charlotte. Champlain clays. The bones of a *Beluga*, a species of white whale, were found near here while excavating a railroad cut in 1849, one hundred and fifty feet above the ocean. The subdivision proposed by C. B. Adams in 1846 was that of the lower "Blue clay," containing a deep-sea fauna, and an upper "Brown clay," carrying littoral species. Several years later, Dawson proposed the names of "Leda clay" and "Saxicava sand" for the synchronous deposits in the St. Lawrence Valley.

30. Georgia. This town has furnished thirty or forty species of trilobites and other fossils of the Middle Cambrian, or a horizon between the Potsdam sandstone of New York and the St. Johns or Acadian group of New Brunswick and Eastern Massachusetts.

Ms. | Central Vermont Railroad.			Ms. | Bennington and Rutland R. R.—Con.		
Western Division.			30 Manchester. ¹⁵ 3 b. Camb. Sil. Limest.		
0 St. Albans.	2 j. Potsdam Slate.	390	39 Arlington. ³¹	"	471
9 Swanton.	"	160	44 Shaftsbury.	"	
Northern Division.			51 N. Bennington.	"	
0 St. Albans.	2 j. Potsdam Slate.	390	55 Bennington.	"	
Georgia. ³⁰	"		61 T. & B. June'n.	2. Cambrian (Taconic) sl.	
9 East Swanton.	"		Boston and Lowell Railroad.		
17 Province Line.	3 b. Lewis Limestone.		Vermont Division.		
Eastern Division.			0 Lunenburg.	Lyman Gp. and D. Hur.	
0 St. Albans.		390	7 Miles Pond.	C. Montalban.	881
10 Sheldon.	D. Huronian.	374	13 West Concord.	E. Coös Group.	857
18 Enosburg Falls.	"	436	21 St. Johnsbury. ³²	E. Calcif's Mica Sch.	591
28 Richford.	"	473	83 Danville.	"	1375
Addison Division.			41 Walden.	"	1678
0 Leicester Junc.	3 c. Chazy.	351	49 Greensboro.	"	1166
3 Whiting.	"		57 Hardwick. ³⁶	"	881
7 Shoreham.	" and 3 a.		62 Wolcott.	D. Huronian.	705
9 Orwell.	2 c. Calcifer's Sandrock.		70 Morrisville.	"	659
15 Larabee's Point.	4 a. Trent. & La Motte.		73 Hyde Park.	"	586
16 Ticonderoga.	3 a. Calciferous s. s.		78 Johnson.	"	541
Woodstock Railroad.			86 Cambridge Junc.	"	473
0 White River Jn.		369	104 Sheldon.	"	374
1 Hartford.	D. Huronian.	485	118 Swanton.	"	160
6 Dewey's Mills.	Calcif. Mica Schist.		120 Maquam Bay.	"	
7 Queechee.	"	650	Passumpsic Railroad.		
11 Taftsville.	"	657	0 Sherbrooke, P.Q.	1. Pre-Cambrian.	486
14 Woodstock.	"	697	3 Lennoxville.	"	500
Bennington and Rutland Railroad.			12 North Hatley.	" & 2-7. Silur'n.	
0 Rutland.	2 a. Calcif's Sandst. ³³	619	30 Smith's Mills.	5-7. Silurian.	
6 Clarendon.	"	639	34 Stanstead Junc.	Granite.	
9 Wallingford.	"		40 Newport, Vt.	E. Calc. Mica Schist.	703
13 S. Wallingford.	3 c. Chazy Marble.		43 Coventry.	"	
18 Danby and } Mt. Tabor.	3 a. Calcif's Sandstone.		55 Barton.	"	959
25 East Dorset.	" & Chazy Marble		68 West Burke.	"	1040
			76 Lyndonville.	"	741
			84 St. Johnsbury. ³²	"	591
			87 Passumpsic.	"	
			94 Barnet.	"	466
			105 Wells River.	D. Huronian.	443

31. Arlington. A few miles east, in the edge of Sunderland, is the best-known exposure of the junction of the Potsdam quartzite with the unconformably underlying gneiss of the Green Mountains. The blue quartz of the granite veins crossing the gneiss is recognized as the source of the grains of sand in the quartzite. Also an excellent locality for the *Scolithus*.

32. St. Johnsbury. Eastern Vermont is largely underlain by a mica schist having a micaceous limestone interstratified with it, to which the name of "calciferous mica schist" is applied in the State reports. It is called "Silurian" when it passes into Canada, and "Montalban mica schist" in Massachusetts. Protracted studies show the strata to be disposed in a synclinal attitude, overlying clay slate. Numerous areas of granite have been erupted through it, both in Vermont and Canada. There is an excellent development of this rock at St. Johnsbury Center and at Danville.

33. Fairlee. A few miles west of this station is the famous Ely copper-mine, for many years the greatest producer of the metal from the yellow sulphuret of any mine in the United States. Six miles west of Pompanoosuc are other copper-mines, and an establishment producing coppers.

34. Norwich and Hanover. A few rods east of the station, on the east side of the Connecticut, the escar has been cut through by erosion, showing an anticlinal ridge of gravel underlying the terraces of Hanover Plain. The same ridge has been cut by White River at White River Junction, where the same structure is observable.

35. Hanover. The collections of the Geological Survey of the State are placed in the Museum of the State Agricultural College. A marked feature is the arrangement of over three thousand lithological specimens in geographical order, taken along thirteen parallel sectional lines across New Hampshire and Vermont. Colored geological profiles accompany the specimens, with the locations and dips indicated, so that one can discover the mutual relations of the rocks without the labor of traveling over the country. In the same room is a large relief map of the same States, colored geologically, upon the horizontal scale of one mile to the inch.

Ms.	Passumpsic Railroad.—Con.	Ms.	Passumpsic Railroad.—Con.
110	Newbury. D. Huronian. 426	129	North Thetford. D. Huronian. 428
113	{ S. Newbury & Haverhill, N.H. } " 412	131	{ Thetford & Lyme, N.H. } E. Coös Group. 418
117	Bradford. " 410	141	{ Norwich ³⁴ & Hanover, ³⁵ N.H. } D. Hornblende Sch. 406
124	{ Fairlee & Orford, N.H. } " 438	145	White River Jn. " 369

Connecticut.³⁷

New York, New Haven and Hartford Railroad.			Hartford Division.—Con.	
New York and New Haven Division.			86 Wallingford.	16. Triassic.
0 New York.	C. Montalban.	52	89 Yalesville.	" 121
11 W'ms Bridge.	Crystalline Limestone.		92 Meriden.	" 68
14 Mount Vernon.	"		99 Berlin.	"
17 New Rochelle.	B. Mid. Lau'n Gneiss. ³²		105 Newington.	" 39
21 Mamaroneck.	"		110 Hartford.	"
22 Harrison.	"		116 Windsor.	" 40
24 Rye.	"		121 Windsor Locks.	"
26 Port Chester.	"		122 Warehouse Pt.	"
29 Greenwich.	"		124 Enfield Bridge.	"
30 Cos Cob.	"		127 Thompsonville.	"
34 Stamford, Conn.	"	12	136 Springfield.	"
37 Noroton.	"		Shore Line Division.	
38 Darien.	"		New York.	C. Montalban.
42 South Norwalk.	"		0 New Haven.	16. Triassic. 10
45 Westport.	"		2 Fair Haven.	"
50 Southport.	"		8 Branford.	Laurentian Gneiss.
51 Fairfield.	"		11 Stony Creek.	"
56 Bridgeport.	"	9	16 Guilford.	Anthophyllitic Gneiss.
60 Stratford.	E. Calcif's Mica Schist.		20 Madison.	"
61 Naugatuck Jun.	"		23 Clinton.	"
64 Milford.	D. Huronian.		28 Westbrook.	Gneiss.
74 New Haven.	16. Triassic. 10		31 Saybrook.	" light colored.
Hartford Division.			33 Conn. River.	
74 New Haven.	16. Triassic. 10		34 Lyme.	Laurentian Gneiss.
80 North Haven.	"		39 South Lyme.	"
			43 East Lyme.	"

86. Hardwick. A few miles north, in Craftsbury, is the celebrated concretionary granite, in which concentric balls of mica are numerous interspersed, to which the local name of "petrified butternuts" has been applied.

37. NOTE.—The very minute description of the foliated crystalline rocks of Connecticut by J. G. Percival furnishes the basis for the following attempted correlation of them with similar groups elsewhere. The Trias divides the crystalline into an eastern and western "Primary"—and Roman letters were used by Percival for the subdivisions of the western primary group. A. is undoubtedly the Huronian of the upper Connecticut. B. is the range of clay slate to the west, the same with that in Bernardston, near Guilford, Vt., and the Ammonoosuc gold-field, N. H. C. is the calciferous mica schist. D. is probably Middle Laurentian. E., F., G., H., and I. belong to the Green Mountain gneiss, perhaps partly Montalban. K. is Lower or typical Laurentian. L., M., N., O., and P. are the Cambro-Silurian lime-stones and schists called Taconic by Emmons. The A. and B. of the eastern Primary comprise both Lower and Middle Laurentian. C. is probably Montalban. D. and E. are the southward extension of the ancient Laurentian gneiss of Worcester County, and F. is closely allied to the Montalban.

Percival did not determine the nature of the "traps" of Connecticut, but showed their arrangement in curves; Professor Dana determined the constituent minerals to be pyroxene and labradorite with magnetite. Dr. G. W. Hawes confirmed this determination, but uses the name diabase instead of dolerite; Percival found, in both the eastern and western primary, systems of dikes parallel to the borders of the Trias entirely through the State; these are anhydrous, while those in the sandstones are mostly hydrous and amygdaloidal.

Shore Line Division.— <i>Con.</i>			Shepaug Railroad.— <i>Con.</i>		
Ms.			Ms.		
47	Waterford.	Laurentian Gneiss.	24	Roxbury Falls.	B. Middle Laurentian.
50	New London.	"	27	Shepaug.	"
112	Providence.	14. Coal Measures.	32	Hawleyville.	"
156	Boston.	2. Cambrian.	38	Bethel.	"
New Canaan Railroad.			Naugatuck Railroad.		
0	New Canaan.	B. Middle Laurentian.		New Haven.	16. Triassic.
9	Stamford.	"	0	Bridgeport.	B. Middle Laurentian.
Danbury and Norwalk Railroad.			3	Stratford.	E. Calcifer's Mica Schist.
	Wilson Point.	B. Middle Laurentian.	5	Junction.	"
0	South Norwalk.	"	14	Derby.	"
18	Sanford.	"	16	Ansonia.	B. Middle Laurentian.
24	Bethel.	"	20	Seymour.	"
27	Danbury.	Limestone. 397	23	Beacon Falls.	"
Ridgefield Branch.			27	Naugatuck.	"
0	Ridgefield.	B. Middle Laurentian.	28	Union City.	"
	South Norwalk.	"	32	Waterbury.	"
Housatonic Railroad.			35	Oakville.	"
	New Haven.	16. Triassic.	38	Watertown.	"
0	Bridgeport.	B. Middle Laurentian.	35	Waterville.	"
10	Stepney.	"	42	Thomaston.	"
16	Botsford.	"	47	Campville.	"
19	Newtown.	"	49	Litchfield.	"
23	Hawleyville.	" 306	52	Torrington.	A. Lower Laurentian.
27	Brookfield Jun.	B. Mid. Laurentian.	57	Burrville.	"
29	Brookfield.	" 338	61	Winsted.	"
35	New Milford.	Limestone abundant. 224	Hartford & Conn. Western R. R.		
42	Merwinsville.	"	0	Hartford.	16. Triassic.
48	Kent.	"	6	Bloomfield.	"
57	Cornwall Bridge.	A. Lower Laurentian.	10	Scotland.	"
61	West Cornwall.	"	12	Tariffville.	Diabase Range.
65	Lime Rock.	3-4. Camb. Sil. Limest.	15	Simsbury.	16. Triassic.
67	Falls Village.	"	22	Canton.	B. Middle Laurentian.
73	Canaan.	" 627	24	Collinsville.	"
75	Ashley Falls.	"	28	Pine Meadow.	"
79	Sheffield.	"	29	New Hartford.	" 389
85	Gt. Barrington.	"	35	Winsted.	A. Lower Laurentian.
87	Van Deusenville.	"		Naugatuck Dep.	"
89	Housatonic.	"	36	West Winsted.	"
91	Glendale.	"		Colebrook.	"
93	Stockbridge.	"	45	Norfolk.	" 1220
95	South Lee.	"	48	West Norfolk.	B. Middle Laurentian.
99	Lee.	"	52	East Canaan.	2 b. Potsdam Quartzite.
101	Lenox Furnace.	"	55	Canaan.	3-4. Camb. Sil. Limest.
102	Lenox.	"	60	Chapinsville.	Cambro-Silurian.
106	Dewey's.	"	62	Salisbury.	Camb. Sil. Limestone.
110	Pittsfield.	"	64	Lakeville.	" 670
	North Adams.	"	66	Ore Hill.	4 c. Lorraine Group.
87	Van Deusenville.	"	67	State Line Junc.	3-4. Camb. Sil. Limest.
95	W. Stockbridge.	"	70	Mount Riga.	"
98	State Line.	3-4. Camb. Sil. Schists.	74	Boston Corners.	"
Shepaug Railroad.			78	Copake.	"
0	Litchfield.	B. Middle Laurentian.	84	Ancram.	2-4. Camb. Sil. Schists.
6	Morris.	"	86	Gallatinville.	"
8	Romford.	"	91	Jackson Corners.	"
12	New Preston.	Limestone.	96	Ellerslie.	"
13	Washington.	B. Middle Laurentian.	103	Red Hook.	"
20	Roxbury.	"	107	Rhinebeck.	"
				Rhinecliff.	"
			110	Rhinebeck Junc.	"

96 AN AMERICAN GEOLOGICAL RAILWAY GUIDE. (NEW ENGLAND.)

Ms. | Central Vermont Railroad.

256	Stafford.	B. Middle Laurentian.
262	Tolland.	"
266	Morrow.	"
268	Mansfield.	"
270	Eagleville.	"
276	Willimantic.	"
280	S. Windham.	C. Montalban.
283	Lebanon.	"
286	Franklin.	"
289	Yantic.	"
293	Norwich.	"
296	Mohegan.	"
298	Massapeag.	A. Older Laurentian.
300	Montville.	"
303	Waterford.	"
306	New London.	"

Providence and Worcester Railroad.

0	Providence.	14. Coal Measures.
4	Pawtucket.	"
6	Valley Falls.	"
7	Lonsdale.	3-4. Camb. Silurian.
9	Ashton.	"
11	Albion.	"
13	Manville.	"
16	Woonsocket.	"
18	Waterford.	A. Laurentian.
	Blackstone.	"
20	Millville.	"
25	Uxbridge.	"
26	Whitin's.	"
31	Northbridge.	"
33	Farnum's.	"
34	Saundersville.	"
35	Sutton.	"
38	Millbury.	"
43	S. Worcester.	Mica Schist.
44	Worcester.	"

Stonington and Providence Railroad.

0	New London.	A. Laurentian.
9	Mystic.	"
12	Stonington.	"
18	Westerly.	"
26	Wood Riv. Jun.	"
35	Kingston.	"
42	Wickford Junc.	"
48	Greenwich.	14. Carboniferous.
53	Hill Grove.	"
57	Auburn.	"
62	Providence.	"

New York and New England Railroad.

0	Boston.	3-4. Cambrian.
46	East Douglass.	Quartzite.
53	E. Thompson, Ms.	C. Montalban.
57	Thompson, Ct.	"
61	Putnam.	"
66	Pomfret.	B. Middle Laurentian.
68	Abington.	"

Ms. | N. Y. & New England R. R.—Con.

74	Hampton.	B. Middle Laurentian.
86	Willimantic.	A. Laurentian. 222
95	Andover.	"
105	Vernon.	" 242
109	Manchester.	C. Montalban.
115	E. Hartford.	16. Triassic.
117	Hartford.	" 39
121	Elmwood.	"
123	Newington.	"
127	New Britain.	" 179
132	Plainville.	" 191
133	Forrestville.	"
136	Bristol.	B. Middle Laurentian.
140	Terryville.	"
148	Waterville.	"
150	Waterbury.	" 260
158	Towantic.	"
161	Southford.	"
164	Pomperaug Val.	16. Triassic.
169	Sandy Hook.	B. Middle Laurentian.
171	Newtown.	"
174	Hawleyville.	" 306
180	Danbury.	" 397
185	Mill Plain, N. Y.	"
191	Brewster.	" 406
196	Towner's.	A. Older Laurentian. 423
198	Patterson.	"
204	Pawling.	A. Older Laurentian.
207	Poughquag.	3-4. Camb. Sil. Limest.
210	Stormville.	"
215	Hopewell.	"
219	Brinkerhoff.	" 223
221	Fishkill, N. Y.	" 212
225	Matteawan.	2 b. Potsdam.
228	Fishkill Land'g.	4 c. Lorraine.
229	Newburgh.	"

Norwich Division.

0	Worcester.	Mica Schist.
1	S. Worcester.	"
5	Auburn.	"
9	North Oxford.	"
11	Oxford.	"
15	North Village.	B. Middle Laurentian.
16	Webster, Mass.	"
20	{ N. Grosven- }	"
	{ ord'le, Ct. }	"
21	Grosvenordale.	"
24	Mechanicsville.	"
26	Putnam.	C. Montalban.
31	Dayville.	"
34	Danielsonville.	"
39	Wauregan.	"
40	Central Village.	"
44	Plainfield.	"
50	Jewett City.	"
58	Greeneville.	"
60	Norwich.	"
73	New London.	Laurentian.

N. Y. & New England R. R.—Con.
Hartford Division.

0 Springfield.	16. Triassic.
3 Armory Station.	"
4 Water-Shops.	"
7 E. Longmeadow.	"
10 Shaker Station.	"
12 Hazardville.	"
16 Melrose.	"
17 Broad Brook.	"
19 Osborn.	"
23 E. Windsor Hills.	"
26 South Windsor.	"
27 Burnham's.	"
29 East Hartford.	"
31 Hartford.	"

Melrose Branch.

16 Melrose.	16. Triassic.
17 Sadd's Mills.	"
19 Ellington.	"
21 Windermere.	C. Montalban.
23 West Street.	"
24 Rockville.	"

Providence Division.

0 Providence.	14. Coal Measures.
4 Cranston.	"
7 Oak Lawn.	"
9 Pontiac.	"
9 Natick.	Laurentian.
11 River Point.	"
Arctic.	"
Centerville.	"
13 Quidnick.	"
14 Anthony.	"
15 Washington.	"
18 Coventry.	"
Summit.	A. Laurentian.
24 Greene.	"
27 Oneco.	"
29 Sterling.	"
32 Moosup.	"
35 Plainfield.	C. Montalban.
Packerville.	"
40 Canterbury.	"
Jewett City.	"
46 Versailles.	"
48 Baltic.	"
51 Scotland.	"
55 S. Windham.	"
58 Willimantic.	B. Middle Laurentian.

New Haven and Northampton R. R.

0 New Haven.	16. Triassic.	
6 Centerville.	"	
9 Mount Carmel.	"	114
15 Cheshire.	"	166
20 Hitchcock.	"	
Plantsville.	"	
22 Southington.	"	152
27 Plainville.	"	191

Ms. | New Haven & Northampton R. R.—Con.

31 Farmington.	16. Triassic.	204
37 Avon.	"	242
39 Westogue.	"	
42 Simsbury.	"	167
47 Granby.	"	204
Congamond.	"	
55 Southwick, Mass.	"	242
61 Westfield.	"	
68 Southampton.	"	195
71 Easthampton.	"	169
76 Northampton.	16. Triassic and Syenite.	
80 Hatfield.	"	
85 Whately.	16. Triassic.	
88 South Deerfield.	"	
93 Conway.	E. Calcif's Mica Schist.	
95 Conway Junc.	"	
99 Shelburne Falls.	Middle Laurentian.	
108 Charlemont.	D. Huronian.	
111 Zoar.	"	
116 Hoosac Tunnel.	B. Middle Laurentian.	
123 North Adams.	3-4. Camb. Sil. Limest.	

Boston and New York Air Line.

0 New Haven.	16. Triassic.	
5 Montowee.	"	
8 Northford.	"	
12 Wallingford.	"	
18 Middlefield.	"	
19 " Centre.	"	
20 Rockfall.	"	
24 Middletown.	"	23
25 Portland.	"	
30 Cobalt.	C. Montalban.	
33 East Hampton.	"	
36 Lyman Viad.	"	
39 West Chester.	B. Middle Laurentian.	
44 Turnerville.	"	
49 Liberty Hall.	"	
54 Willimantic.	"	

ADDITIONAL RAILROADS IN MAINE.

St. Croix and Penobscot Railroad.

0 Calais.	Granite and Syenite.
2 Milltown.	"
5 Baring, N. B.	Syenite.
Princeton, Me.	Calciferous Mica Schist.

Sandy River Railroad.

0 Farmington.	E. Pre-Cambrian.
3 N. Farmington.	" Mica Schist.
11 Strong.	"
18 Phillips.	" with Limestone.

Bangor and Katahdin Iron Works R. R.

0 Bangor.	Huronian.
39 Milo Junction.	"
45 Brownville.	Cambrian slate quarries.
Katahdin I. W.	Bog ore making charcoal-iron.

The RAILROADS OF RHODE ISLAND are given in the chapters on Massachusetts and Connecticut.

This blank space is intended for additional geological notes in pencil by the traveler.

Massachusetts.

BY PROFESSOR W. O. CROSBY, OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
BOSTON, MASS.

Table of the Geological Formations of Massachusetts.

Cenozoic.		Eozoic. ¹	
20. Quaternary.	20 b. Champlain Clay and Gravel.	4. Taconian.	4 c. Taconian Schist.
"	20 a. Glacial Drift.	"	4 b. Stockbridge Limestone.
19. Tertiary.	19 b. Miocene.	4 a. Quartzite.	
"	19 a. Eocene.	3. Montalban.	3 f. Serpentine and Chlorite Schist.
Mesozoic.		"	3 e. Hornblende Rock and Schist, and Hydro-Mica Schist.
16. Triassic.	16. Triassic.	"	3 d. Argillite and Quartzite.
Paleozoic.		"	3 c. Mica Schist (many varieties).
14. Carbonifer's	14 b. Coal Measures.	"	3 b. Gneiss (many varieties)
"	14 a. Millstone Grit.	"	3 a. Granite.
6. Silurian.	6. Lower Helderberg.	2. Huronian.	2 e. Limestone and Serpentine.
5. Cambrian.	5. Acadian.	"	2 d. Stratified Diorite, Slate, Quartzite, etc.
		"	2 c. Eruptive Diorite, etc.
		"	2 b. Petrosilex and Felsite.
		"	2 a. Granite.
		1. Norian.	1. Syenite, etc.

Ms.	Eastern Railroad.	Alt.	Ms.	Eastern Railroad—Con.	Alt.
0	Boston. ¹	10	37	Newburyport.	2 a. Gran. & 2 c. Dio. ¹²⁴
2	Somerville.	8	39	Salisbury.	"
3	Everett.		43	Seabrook.	3 c. Mica Schist.
5	Chelsea. ²		47	Hampton.	"
6	Revere.		51	Greenland.	"
11	Lynn. ³		57	Portsmouth.	"
13	Swampscott.		58	Kittery.	" 17
16	Salem.		63	Elliot.	" 21
18	Beverly.		67	Conway Junc.	"
21	North Beverly.		70	S. Berwick Jn.	"
23	Wenham.		75	North Berwick.	"
28	Ipswich.		80	Wells.	2 a. Granite.
31	Rowley.		89	Kennebunk.	5. Cambrian.
34	Knight's Cross. ⁴		94	Biddeford.	" and Granite.
			95	Saco.	5. Cambrian.
			103	Scarboro.	2. Huronian.
			108	Portland.	" 13

1. The central portion of Boston, embracing the termini of all the railroads entering the city, rests on an unbroken drift formation; but numerous excavations and borings have shown that the underlying rock is the Acadian or Brainerd slate. Artesian wells on Causeway and Providence Streets have penetrated the slate to depths of 1,700 and 2,500 feet.

2. The hills in Chelsea and vicinity are fine examples of lenticular drift hills or drumlins.

3. The adjacent rocky peninsula of Nahant consists chiefly of coarse diabase, which intersects Acadian slate and limestone at East Point.

4. This is an interesting locality. South of the station is the Parker River basin, which is a closed synclinal of Acadian slate and conglomerate, resting on banded petrosilex, and including contemporaneous beds of melaphyre. Within half a mile of the station, toward the northwest, are the Devil's Den and Devil's Basin, abandoned quarries of limestone and serpentine, which have afforded specimens of *Boscon*.

Eastern Railroad—Con.			Ms.	Conway Branch.	
Saugus Branch.					
3 West Everett.	20 b. Clay and Gravel.		67	Conway Junc.	3 c. Mica Schist.
5 Malden.	5. Acadian Slate.		69	Salmon Falls.	3 d. Argillite.
7 Maplewood.	"		73	Great Falls.	"
8 Linden.	20 a. Glacial Drift.		79	Rochester.	3 c. Mica Schist.
9 Cliftondale.	2 b. Petrosilex & Felsite.		87	Milton.	"
10 Saugus.	"		97	Wolfboro Junc.	3 b. Gneiss.
11 East Saugus.	"		104	N. Wakefield.	"
12 Raddins.	"		114	Ossippee.	"
			124	Madison.	"
			138	Conway.	3 a. Granite.
Swampscott Branch.					
13 Swampscott.	2 c. Eruptive Dior., etc.				
15 Phillip's Beach.	"		97	Wolfboro Jn.	3 b. Gneiss.
16 Clifton.	"		109	Wolfboro.	"
17 Marblehead. ⁵	"				
South Reading Branch.					
18 Peabody.	2 c. Erupt. Diorite, etc.				
22 Lynnfield.	2 a. Granite.				
23 Montrose.	2 c. Erupt. Diorite, etc.				
25 Wakefield.	"				
Salem and Lawrence Branch.					
18 Peabody.	2 c. Erupt. Diorite, etc.				
20 Danversport.	"				
21 Danvers.	"				
22 Beaver Brook.	2 d. Stratified Dior., etc.				
25 Middleton.	2 c. Erupt. Diorite, etc.				
29 Boxford.	3 b. Gneiss.				
34 North Andover.	"				
36 Lawrence.	3 c. Mica Schist.	66			
Gloucester Branch.					
18 Beverly.	2 a. Granite.				
22 Beverly Farms.	"				
25 Manchester. ⁶	"				
27 Magnolia.	"				
31 Gloucester.	"				
35 Rockport. ⁷	"				
Essex Branch.					
23 Wenham.	2 c. Erupt. Diorite, etc.				
24 Hamilton.	"				
28 Essex.	2 a. Granite.				
Amesbury Branch.					
39 Salisbury.	2 a. Granite.				
43 Amesbury.	20 a. Glacial Drift.				
Dover Branch.					
57 Portsmouth.	3 c. Mica Schist.				
61 Newington.	"				
65 Cushing's.	"				
68 Dover.	3 a. Granite.				
			Medford Branch.		
			2	Somerville.	5. Acadian Slate.
			4	Glenwood.	20 b. Champlain Clay.
			6	Medford.	5. Acadian Slate & Congl.

5. The rocky peninsula of Marblehead Neck, lying opposite the town, across the harbor, is composed chiefly of granite (2 a) and many varieties of petrosilex and felsite (2 b). On the shore north of the town are fine exposures of the Norian syenite (1), both stratified and eruptive.

6. The celebrated singing beach is not far from the station.

7. The most important of the Cape Ann granite-quarries are in the town of Rockport.

Boston and Maine Railroad—Con.			Boston and Lowell Railroad—Con.		
Ms. | Georgetown and Newburyport Branch.			Ms. | Middlesex Central Branch.		
10 Wakefield.	2 c. Erupt. Diorite, etc.		3 Somerville.	5. Acadian Slate.	
18 Lynnfield.	2 c. Limest. & Serpent'ne		4 W. Somerville.	"	
15 W. Peabody.	2 c. Eruptive Diorite.		5 Arlington.	2 a. Granite.	
19 Danvers.	"		6 Arlingt'n H'ghts.	2 c. Erupt. Diorite, etc.	
25 Topsfield. ¹⁰	2 a. Granite.		9 East Lexington.	"	
28 Boxford.	2 d. Strat. Diorite, etc.		11 Lexington.	"	
31 Georgetown.	2 c. Erupt. Diorite, etc.		15 Bedford.	3 b. Gneiss.	135
34 Byfield.	"		19 Concord.	"	
40 Newburyport.	2 a. Granite.	124	21 Prison Station.	"	
Georgetown and Bradford Branch.			Salem and Lawrence Branches.		
31 Georgetown.	2 c. Erupt. Diorite, etc.		26 Lowell.	3 c. Mica Schist.	99
34 Groveland.	3 c. Mica Schist, Argil.		31 Tewksbury Jn.	3 b. Gneiss.	124
38 Bradford.	"		33 Hagget's.	"	
Lowell and Andover Branch.			38 Lawrence.	3 b. Mica Schist.	65
20 Lowell Junc.	3 b. Gneiss.	103	34 Wilmington Jn.	3 b. Gneiss.	88
22 Tewksbury.	"	124	38 North Reading.	2 d. Strat. Diorite, etc.	
27 Lowell.	3 c. Mica Schist.	99	43 West Peabody.	"	
Dover and Alton Bay Branch.			46 Peabody.	2 c. Erupt. Diorite, etc.	
67 Dover.	3 a. Granite.		48 Salem.	1. Syenite, etc.	
75 Gonic.	3 d. Argillite, etc.		Stony Brook Branch.		
77 Rochester.	3 c. Mica Schist.		26 Lowell.	3 c. Mica Schist.	99
85 Farmington.	"		29 N. Chelmsford.	"	
91 New Durham.	"		31 W. Chelmsford.	3 a. Granite.	
94 Alton.	"		33 Westford.	"	102
95 Alton Bay.	3 b. Gneiss.		35 Graniteville. ⁸	"	
Boston and Lowell Railroad.			36 Forge Village.	"	
0 Boston. ¹	20 a. Glacial Drift.	13	42 Ayer Junction.	3 c. Mica Schist.	230
3 Somerville.	5. Acadian Slate.	8	Nashua and Acton Branch.		
4 College Hill.	"	31	0 Nashua.	3 c. Mica Schist.	
5 West Medford.	"	21	6 Dunstable.	3 b. Gneiss.	61
8 Winchester.	2 c. Erupt. Dior., etc. ²⁷		9 East Groton.	3 c. Mica Schist.	
10 Woburn.	"		15 Westford.	3 a. Granite.	
11 Stoneham.	"		16 East Littleton.	3 b. Gneiss.	
15 Wilmington.	3 b. Gneiss.	97	20 North Acton.	"	
19 Billerica.	"	110	22 Acton.	"	44
22 North Billerica.	"	120	23 Prison Station.	"	
26 Lowell.	3 c. Mica Schist	99	Boston, Revere Beach, and Lynn Rail- road.		
28 No. Chelmsford.	"	106	0 Boston. ¹	20 a. Glacial Drift.	10
32 Tyngsboro.	3 a. Granite.		1 East Boston.	"	
40 Nashua.	3 c. Mica Schist.	134	3 Winthrop Junc.	"	
45 Merrimack.	3 d. Argillite, etc.	258	4 Beachmont. ⁹	"	
48 Amherst.	3 b. Gneiss.	244	6 Atlantic.	20 b. Beach Gravel.	
51 Milford.	"	244	7 Point of Pines.	"	
55 Wilton.	3 c. Mica Schist.	328	9 West Lynn.	2 b. Petrosil. and Felsite	
59 So. Lyndeboro.	3 b. Gneiss.	335	10 Lynn.	"	
66 Greenfield.	"				
71 Hancock Junc.	"				
75 Hancock.	"				
82 Harrisville.	"				
89 Marlboro.	"	278			
96 Keene.	"				

8. The Chelmsford granite, so called, is extensively quarried near this station.

9. This railroad runs from Beachmont to Point of Pines on the crest of Revere Beach, a remarkable barrier thrown up by the surf between the sea and the marshes of Revere and Saugus.

10. The celebrated Trilobite quarry, a quarry in the Acadian slate, which has afforded large and fine specimens of *Paradoxides Harlani*, is on the banks of Hayward's Creek and Weymouth Fore River, two miles southeast of Quincy station, and one mile north of East Braintree station.

11. Fall River is on the boundary between the Carboniferous conglomerate and the Montalban

Ms. | Old Colony Railroad.		Ms. | Plymouth and South Shore Division.	
0 Boston. ¹	20 a. Glacial Drift.	10 Braintree.	2 a. Granite.
3 Savin Hill.	5. Acadian Conglom.	11 E. Braintree. ¹⁰	5. Acadian Slate.
4 Harrison Square.	"	12 Weymouth.	" and 2 a.
5 Neponset.	"	13 N. Weymouth.	2 a. Granite.
6 Atlantic.	"	15 East Weymouth.	"
7 Wollaston.	20 a. Glacial Drift.	16 West Hingham.	5. Acadian Conglom.
8 Quincy. ¹⁰	5. Acadian Slate.	17 Hingham.	2 a. Granite.
9 Quincy Adams.	2 a. Granite.	19 Nantasket.	" 155
10 Braintree.	"	22 Cohasset.	"
11 South Braintree.	"	25 Egypt.	"
14 Randolph.	"	27 Scituate. ¹⁵	20 a. Glacial Drift.
17 Stoughton.	2 c. Eruptive Diorite.	30 E. Marshfield.	"
22 North Easton.	2 a. Granite.	34 Marshfield.	"
24 Easton.	14 b. Coal Measures.	36 Webster Place.	"
30 Raynham.	"	38 Duxbury.	"
35 Taunton.	"	39 South Duxbury.	"
37 North Dighton.	14 a. Millstone Grit.	42 Kingston.	"
39 Dighton.	"	46 Plymouth. ²²	"
42 Somerset.	"	11 South Braintree.	2 a. Granite.
48 Fall River. ¹¹	"	15 S Weymouth.	"
54 Tiverton.	"	18 N. Abington.	"
56 Bristol Ferry.	"	21 S. Abington. ¹⁶	14. Carboniferous.
58 Portsmouth. ¹²	14 b. Coal Measures.	24 South Hanson.	"
68 Newport. ¹³	"	30 Plympton.	20 a. Glacial Drift.
Bridgewater and Myrick's Division.		33 Kingston.	"
11 South Braintree.	2 a. Granite.	18 N. Abington.	2 a. Granite.
15 Holbrook.	"	20 Rockland.	"
17 East Stoughton.	"	25 Hanover. ¹⁶	14. Carboniferous.
20 Brockton.	"	Cape Cod Division.	
21 Campello.	14. Carboniferous.	34 Middleboro. ¹⁷	20 a. Glacial Drift. 96
26 Bridgewater.	"	39 Rock.	3 a. Granite.
34 Middleboro.	" 96	45 Tremont.	20 a. Glacial Drift.
42 Myrick's.	"	49 Wareham.	" 8
45 Assonet.	3 a. Granite.	54 Buzzard Bay.	"
50 Fall River. ¹¹	14 a. Millstone Grit.	62 Sandwich.	" 13
Shawmut and Milton Branches.		69 W. Barnstable.	" 37
4 Harrison Square.	5. Acadian Conglom.	73 Barnstable.	" 57
5 Shawmut.	5. Acadian Slate.	75 Yarmouth.	" 40
6 Cedar Grove.	5. Acadian Conglom.	80 So. Yarmouth.	"
7 Milton L. Mills.	"	84 Harwich.	"
8 Mattapan.	"	89 Brewster.	"
Granite Branch.		94 Orleans.	" 44
6 Atlantic.	5. Acadian Conglomer.	97 Eastham.	" 13
8 E. Milton.	5. Acadian Slate.	103 Wellfleet.	" 14
9 West Quincy. ¹⁴	2 a. Granite.	111 Truro.	"
		120 Provincetown.	"

granite (3a). There are important quarries in the granite, and the quartzite pebbles in the conglomerate contain Primordial forms of *Lingula*.

12. The most extensive coal-mines in New England are at the Coal Mine Station in Portsmouth.

13. The shore east and south of the city gives a very good section of the Carboniferous strata. The chasm called Purgatory is on the shore two miles from Newport. Newport Neck is chiefly composed of granite and metamorphic slates.

14. The important granite-quarries of Quincy are chiefly in the immediate vicinity of this village.

15. Outcrops are almost unknown between Scituate and Plymouth, but the drift probably rests at most points on Huronian granite (2 a).

16. The drift of this region is thick and unbroken, and there is much doubt concerning the boundaries of the underlying formations.

17. South and east of Middleboro the rocks are very rarely exposed, and Barnstable County, in which the greater part of this division lies, does not include a single outcrop. The cliffs near Highland Light, in Truro, on the extremity of Cape Cod, afford fine sections of the drift deposits, and also include fragments of calcareous sandstone, filled with characteristic Eocene fossils, indicating the occurrence of Eocene strata under this part of Massachusetts Bay.

Old Colony Railroad—Con.			Ms. | Fitchburg and Taunton Division—Con.		
Fair Haven Branch.					
45 Tremont.	20 a. Glacial Drift.		46 Medfield.	2 d. Strat. Dior., etc.	
50 Marion.	3 b. Gneiss.		50 Walpole.	14 a. Millstone Grit.	157
55 Mattapoisett.	"		53 South Walpole.	"	227
60 Fairhaven.	"		55 Foxboro.	2 a. Granite.	284
Wood's Holl Branch.			58 Mansfield.	14 b. Coal Measures.	172
54 Buzzard Bay.	20 a. Glacial Drift.		63 Norton.	"	
58 Pocasset.	"		65 Crane's.	14. Carboniferous.	
62 N. Falmouth.	"		69 Taunton.	"	
65 West Falmouth.	"		Lowell and Framingham Division.		
71 Wood's Holl. ³³	"		0 Lowell.	3 c. Mica Schist.	99
Middleboro and Taunton Branch.			4 Chelmsford.	3 b. Gneiss.	
34 Middleboro.	20 a. Glacial Drift.	96	6 S. Chelmsford.	"	
39 East Taunton.	14. Carboniferous.		9 Carlisle.	"	
44 Taunton.	"		13 Acton.	"	44
Fall River, Warren, and Providence Division.			15 Concord Junct.	"	135
49 Fall River. ¹¹	14. Carboniferous.		18 North Sudbury.	2 d. Strat. Diorite.	
52 Swansea.	"		20 Sudbury.	"	127
56 Warren.	"	593	22 South Sudbury.	3 b. Gneiss.	
60 Bristol.	"		26 Framingham.	"	188
68 Providence.	"		Boston and Providence Railroad.		
Fall River Branch.			0 Boston. ¹	20 a. Glacial Drift.	5
49 Fall River. ¹¹	14. Carboniferous.		2 Roxbury.	5. Acadian Conglom.	20
52 Hemlock.	3 a. Granite.		4 Jamaica Plain.	"	33
57 N. Dartmouth.	3 b. Gneiss.		5 Forest Hills.	"	36
62 New Bedford.	"		6 Mount Hope.	5. Acadian Slate.	
New Bedford Branch.			7 Clarendon Hills.	2 b. Petrosil. & Fels.	50
35 Taunton.	14. Carboniferous.		8 Hyde Park.	5. Acadian Conglom.	51
42 Myrick's.	"		9 Readville.	"	61
49 Braley's.	3 a. Granite.		14 Canton Junct.	2 a. Granite.	
53 Acushnet.	3 b. Gneiss.		15 Canton.	2 c. Erupt. Diorite.	101
56 New Bedford.	"		18 Stoughton.	"	220
Attleboro and Taunton Branch.			18 Sharon.	"	220
35 Taunton.	14. Carboniferous.		22 East Foxboro.	2 a. Granite.	211
40 Barrowsville.	"		24 Mansfield.	14 b. Coal Meas.	169
45 Attleboro.	14 b. Coal Measures.		26 West Mansfield.	"	
Fitchburg and Taunton Division.			31 Attleboro.	"	129
0 Fitchburg. ²⁴	{ 3 c. Mica Schist and 3 a. and b.	430	35 North Attleboro.	"	
3 W. Leominster.	3 c. Mica Schist.		33 Hebronville.	"	
5 Leominster.	"	373	39 Pawtucket.	"	
9 Pratt's Junction.	"	429	40 Providence.	14. Carboniferous.	
12 Sterling.	"		Dedham Branch.		
18 Clinton.	3 d. Argillite, etc.	309	5 Forest Hill.	5. Acadian Conglom.	36
16 Bolton.	3 a. Granite.		6 Roslindale.	5. Acadian Slate.	
18 West Berlin.	3 c. Mica Schist.		8 West Roxbury.	"	
20 Berlin.	3 b. Gneiss.		10 Dedham.	2 a. Granite.	
23 Northboro.	"		New York and New England Railroad.		
30 Marlboro.	2 d. Stratif. Diorite.	378	0 Boston.	20 a. Glacial Drift.	10
31 Southboro.	3 b. Gneiss.	307	3 Dudley St.	5. Acadian Conglom.	
32 Fayville.	"		4 Mount Bowdoin.	"	
35 Framingham.	"	188	5 Dorchester.	5. Acadian Slate.	
37 S. Framingham.	"	163	6 Mattapan.	2 b. Petrosil. & Felsite.	
40 Sherborn.	2 d. Strat. Dior., etc.	177	8 Hyde Park.	5. Acadian Conglom.	51
			10 Readville.	"	61
			11 Elmwood.	2 a. Granite.	
			13 Ellis.	"	
			15 Norwood.	"	

New York and New England Railroad—
Ms. | *Continued.*

19 Walpole.	14 a. Millstone Grit.	
23 Norfolk.	2 c. Eruptive Diorite.	
27 Franklin.	"	
30 Wadsworth's.	"	
36 Blackstone.	3 c. Mica Schist.	197
40 Ironstone.	3 b. Gneiss.	217
46 East Douglas.	"	
48 Douglas.	"	
52 East Thompson.	"	

Southbridge Extension.

52 East Thompson.	3 b. Gneiss.	
58 East Webster.	3 c. Mica Schist.	
59 Webster.	"	
64 Quinnebaug.	"	
67 West Dudley.	3 b. Gneiss.	
70 Southbridge.	"	

Woonsocket Division.

0 Boston. ¹	20 a. Glacial Drift.	10
10 { Newton Upper Falls.	5. Acad. Sl. & Congl.	
12 Needham.	2 b. Petrosil. & Felsite.	
14 Charles River.	2 a. Granite.	
16 Dover.	"	
20 Medfield.	2 c. Eruptive Diorite.	
25 Medway.	"	
29 N. Bellingham.	3 c. Mica Schist.	
35 E. Blackstone.	"	
38 Woonsocket.	"	

Norwich Division.

0 Worcester. ¹⁸	{ 3 c. and d. Argillite and 3 a. and b.	475
4 Auburn.	3 c. Mica Schist.	
9 North Oxford.	"	
11 Oxford.	"	
16 Webster.	3 b. Gneiss.	

Hartford Division.

0 Springfield.	16. Triassic.	175
7 E. Longmeadow.	"	

Providence Extension.

27 Franklin.	2 c. Erupt. Dio., etc.	292
31 W. Wrentham.	2 a. Granite.	
33 Diamond Hill.	3 b. Gneiss.	

Providence and Worcester Railroad.

16 Woonsocket.	3 c. Mica Schist.	
18 Blackstone.	"	197
25 Uxbridge.	3 b. Gneiss.	231
31 Northbridge.	"	269
35 Sutton.	"	331
38 Millbury.	"	393
44 Worcester. ¹⁸	{ 3 c. and d. Argillite and 3 a. and b.	475

Ms. | **Boston and Albany Railroad.**

0 Boston. ¹	20 a. Glacial Drift.	10
5 Brighton.	5. Acad. Sl. & Congl.	24
7 Newton.	"	46
10 Auburndale.	"	63
12 { Newton Lower Falls.	20 a. Glacial Drift.	
13 Wellesley Hills.	2 a. Granite.	
15 Wellesley.	"	140
18 Natick.	{ 2 a. and d. Granite & Strat. Diorite.	170
21 S. Framingham.	3 b. Gneiss.	183
24 Ashland.	"	184
28 Southville.	"	263
32 Westborough.	"	309
38 Grafton.	"	360
44 Worcester. ¹⁸	{ 3 c. & d. Schist & Argillite, also 3 a. & b. Gran. & Gneiss.	473
53 Rochdale.	3 b. Gneiss.	721
57 Charlton.	"	704
62 South Spencer.	"	606
67 Brookfield.	"	604
69 West Brookfield.	"	593
73 Warren.	"	391
79 West Brimfield.	"	326
84 Palmer.	"	364
89 N. Wilbraham.	"	341
92 Indian Orchard.	16. Triassic.	70
99 Springfield.	"	147
108 Westfield.	"	273
116 Russell.	3 c. Mica Schist.	273
120 Huntington.	"	
126 Chester. ¹⁹	{ 3 c. Mica Schist and 3 e. and f.	595
131 Middlefield.	3 b. Gneiss.	1207
135 Becket.	"	1427
138 Washington.	"	1421
142 Hinsdale.	"	1199
146 Dalton.	4 a. Quartzite.	1013
151 Pittsfield.	4 b. Limestone.	1047
159 Richmond. ²⁰	"	914
162 State Line.	4 c. Taconic Schists.	

Brookline and Newton Highlands Branch.

0 Boston. ¹	20 a. Glacial Drift.	10
4 Brookline.	5. Acad. Sl. & Congl.	10
6 Reservoir.	"	46
8 Newton Centre.	"	
9 Newton Highl'ds	"	

Milford Branch.

21 S. Framingham.	3 b. Gneiss.	183
25 East Holliston.	"	189
26 Holliston.	"	191
30 Braggville.	"	
12 Milford.	"	244

18. The Worcester slates include a bed of anthracite one mile east of the city. It was mined fifty years ago, and granite is now quarried in that vicinity, on Millstone Hill.

19. The emery-mine, one half mile from the station, is an important mineral locality. One mile west of the station the railroad crosses an immense bed of serpentine (3 f.).

20. The Taconian limonite deposits are extensively mined in Richmond, and the celebrated boulder trains are in the western part of the town.

Boston and Albany Railroad—Con.			Worcester, Nashua, and Rochester Railroad—Con.		
Ms.	Webster Branch.		Ms.		
44 Worcester. ¹⁸	3 c. & d. & 3 a. & b.	473	46 Nashua.	3 c. Mica Schist.	
48 Jamesville.	3 b. Gneiss.	564	49 Hudson.	"	221
54 N. Oxford Mills.	"		57 Windham.	"	
56 Howarth's.	"		63 Hampstead.	"	
60 Webster Mills.	"		70 Fremont.	"	60
Ware River Branch.			74 Epping.	"	
0 Winchendon.	3 b. Gneiss.	993	80 Lee.	3 b. Gneiss.	
6 Baldwinville.	"	901	88 Barrington.	3 c. Mica Schist.	
10 Templeton.	"	964	92 Gonic.	"	
16 Williamsville.	"	833	95 Rochester.	"	
22 Cold Brook.	"	672	Boston, Barre, and Gardner Railroad.		
25 Barre Plains.	"	588	0 Worcester. ¹⁸	3 c. & d. and 3 a. & b.	475
33 Gilbertville.	"	546	3 Barber's.	3 c. Mica Schist.	
37 Ware.	"	489	6 Chaffin's.	"	
45 Thorndike.	"	345	8 Holden.	"	758
49 Palmer.	"	336	10 Jefferson's.	3 b. Gneiss.	
Athol Branch.			13 Brooks.	"	30
0 Springfield.	16. Triassic.	70	16 Princeton.	"	
7 Indian Orchard.	"	241	20 Hubbardston.	"	
11 Red Bridge.	3 b. Gneiss.		27 Gardner.	"	1009
17 Three Rivers.	"		38 Winchendon.	"	993
19 Bondsville.	"	350	Fitchburg Railroad.		
23 West Ware.	"	387	Hoosac Tunnel Route.		
27 Enfield.	"	415	0 Boston. ¹	20 a. Glacial Drift.	11
31 Greenwich.	"	445	3 Somerville.	5. Acadian Slate.	8
38 North Dana.	"	462	4 Cambridge.	"	
40 New Salem.	"	522	6 Belmont.	" and 2 c.	73
43 South Athol.	"	561	7 Waverly.	"	132
49 Athol.	"	546	10 Waltham.	"	
Pittsfield and North Adams Branch.			12 Stony Brook.	2 c. Erupt. Dior., etc.	91
0 Pittsfield.	4 b. Limestone.	1013	13 Weston.	"	98
3 Coltsville.	"		17 Lincoln.	2 d. Strat. Dior., etc.	206
6 Berkshire.	"		20 Concord.	3 b. Gneiss.	135
9 Cheshire. ²¹	"		22 Concord June.	"	
12 Cheshire Harb'r.	"		25 South Acton.	"	199
14 Adams.	"		32 Littleton.	" and 3 c.	228
20 North Adams. ²²	"	686	36 Ayer Junction.	3 c. and 3 d.	230
Worcester, Nashua, and Rochester Railroad.			40 Shirley.	3 d. Argillite.	282
0 Worcester. ¹⁸	3 c. & d. and 3 a. & b.	475	42 Lunenburg.	"	
9 West Boylston.	3 c. Mica Schist.	442	45 Leominster.	3 c. Mica Schist.	373
12 Sterling Junc.	"		50 Fitchburg. ²⁴	" & 3 a. & b.	430
17 Clinton.	3 d. Argillite and c.	309	54 Wachusett.	3 b. Gneiss.	
19 Lancaster. ²³	"	269	60 Ashburnham.	"	1106
25 Harvard.	" and 3 a.	288	65 Gardner.	"	1009
28 Ayer Junc.	" and 3 c.	230	71 Baldwinville.	"	891
31 Groton.	3 c. Mica Schist.	303	77 Royalston.	"	
36 Pepperell.	"	205	83 Athol.	"	546
41 Hollis.	"		87 Orange.	" and 3 a.	
			90 Wendell.	3 a. Granite and 3 b.	
			92 Erving.	3 b. Gneiss.	

21. The celebrated Berkshire sand, used in glass-making, results from the disintegration of the Taconic quartzite, and is most extensively quarried in the town of Cheshire.

22. At the Natural Bridge, one and a half miles northeast of the station, is a fine gorge cut out of the Taconic limestone, and a large marble-quarry.

23. The micaceous argillite of Lancaster is noted for the numerous and fine crystals of chialstolite which it contains.

24. Rollstone Hill, immediately south of the city, and Pearl Hill, two miles north, are interesting localities for minerals and rocks. Rollstone Hill is a boss of micaceous granite (3 a.) which is extensively quarried.

Fitchburg Railroad—			Ms. |	Peterboro and Shirley Branch.		
Hoosac Tunnel Route—Con.						
98 Miller's Falls.	3 b. Gneiss and 8.	292		86 Ayer Junction.	3 c. and 3 d.	220
102 Montague.	16. Triassic.	129		40 West Groton.	3 d. Argillite.	
106 Greenfield.	" Sandst. & Trap.			44 Townsend Harb.	"	
110 West Deerfield.	" and 3 c.	161		46 Townsend Cent'r	3 c. Mica Schist.	
114 Bardwell's.	3 c. Mica Schist.	238		48 W. Townsend.	3 b. Gneiss.	
119 { Shelburne Falls.*	{ 3 b. Gneiss.	420		52 Mason Centre.	"	
122 Buckland.	3 c. Mica Schist.			55 Pratt's.	"	423
128 Charlemont.	"			60 Greenville.	"	
132 Zoar.	"			Turner's Falls Branch. 4		
136 Hoosac Tun'l.*	3 e. and 3 f.			0 Greenfield.	16. Triassic.	121
Hoosac Mount.		2610		3 Montague City.	"	129
Do., E. Summit, over Tunnel.		2269		5 Turner's Falls.*	"	170
Hoosac Tunnel, East Portal.		759		New London Northern Railroad.		
Do., Cent. Shaft.		819		50 Stafford.	3 b. Gneiss.	
Do., West Portal.		759		61 Monson.	"	
143 North Adams.*	4 b. Limestone.	686		65 Palmer.	"	236
148 Williamstown.	"	580		68 Three Rivers.	"	
152 Pownal.	" and 4 c.			70 Barrett's Junc.	3 a. Granite.	259
Watertown Branch.				75 Belchertown.	3 b. Gneiss.	460
5 Fresh Pond.	20 b. Champlain Clay.			80 Dwight's.	"	246
6 Mount Auburn.	5. Acadian Slate.			85 Amherst.	3 a. Granite.	225
8 Watertown.	"			88 North Amherst.	"	
10 Waltham.	"			91 Leverett.	"	
Marlborough and Hudson Branch.				94 Mount Toby.	16. Triassic.	
25 South Acton.	3 b. Gneiss.	199		96 Montague.	"	129
28 Maynard.	"			100 Miller's Falls.	" and 3 b.	292
31 Whitman's Cros.	"			103 Northfield Fms.	3 b. Gneiss.	
32 Rockbottom.	"			109 Northfield.	16. Triassic.	
34 Hudson.	"	221		111 South Vernon.	3 c. and 3 d.	
38 Marlboro.	"	378		116 Vernon.	"	
				121 Brattleboro.	"	

25. The falls of the Deerfield River are near the station, and are interesting on account of the numerous large pot-holes exposed, and the contortions and metamorphism of the gneiss, which here marks an important anticlinal axis. One mile west of the station ancient pot-holes are exposed in the railroad cut, fifty feet above the present bed of the river.

26. The rocks traversed by the tunnel are well shown in the vast deposit of *debris* between the station and the eastern portal. The side of the mountain above the portal is serpentine, the same belt that crosses the Boston and Albany Railroad near Chester. One half mile east of the station is a quarry in soapstone and chlorite schist, affording green foliated talc.

Travelers on the Boston and Albany, and Fitchburg Railroads, have a good opportunity to observe the stratigraphy of the mountainous district between the Berkshire and Connecticut Valleys.

The main Hoosac range is probably an overturned or broken anticlinal, the exposed beds nearly all dipping to the east. A synclinal axis is reached at Chester, on the Boston and Albany line, and near Zoar, on the Fitchburg.

Beyond this the strata dip to the west until we reach the anticlinal axis at Shelburne Falls, on the Fitchburg, beyond which they dip to the east again for about eight miles, or until covered by the Triassic beds.

The second anticlinal is not exposed on the Boston and Albany road, passing under the Triassic before it reaches that line.

27. The noted locality of fossil footmarks is on the west bank of the river, one and a half miles above the village. W. W. Draper was the first person to observe them, in 1835. He suggested that they were "turkey tracks made two thousand years ago." His impressions were communicated to Colonel Wilson, who called the attention of Dexter Marsh to them. Mr. Marsh collected many fine slabs, and showed them to Dr. James Dean, who requested Professor E. Hitchcock to investigate them scientifically. This was done, and the results accumulated in the Hitchcock Ichneological Museum at Amherst, where are over twenty thousand separate ichnites, illustrating about one hundred and sixty species, all from the Connecticut Valley.

28. This is the locality furnishing for the Amherst Museum the large rows of tracks of *Brontosaurus Giganteus*, the largest of the Triassic birds. Across the river, in South Hadley, is an excellent locality of *Otosaurus Moodii*, so named for Pliny Moody, who was the first person in the Connecticut Valley known to have observed any of the footmarks. A specimen is preserved which he dug up in 1800, saying that "the tracks were made by Noah's raven."

29. This is the town where the celebrated Helderberg limestone crops out. It is believed to be a remnant of a once extensive deposit, preserved accidentally from erosion, and resting upon or folded beneath the Coos quartzite.

Ms. | Connecticut River Railroad.			New Haven and Northampton Railroad— Ms. | Continued.				
0	Springfield.	16. Triassic.	70	80	Florence.	8 a. Granite.	273
4	Chicopee.	"	79	82	Leeds.	"	356
6	Chicopee Falls.	"		84	Haydenville.	"	432
8	Holyoke.	"	94	85	Williamsburg.	" and 3 c.	492
13	Smith's Ferry.	"	122	88	South Deerfield.	16. Triassic.	207
15	Mount Tom. ²⁸	"		93	Conway.	3 c. Mica Schist.	
17	Northampton.	" and 3 a.	125	99	Shelb'rne F'ls. ²⁵	3 b. Gneiss.	430
21	Hatfield.	16. Triassic.		Housatonic Railroad.			
14	North Hatfield.	"	172	75	Ashley Falls.	4 b. Limestone.	
26	Whateley.	"	186	79	Sheffield.	"	
28	South Deerfield.	"	207	85	Gt. Barrington.	"	
33	Deerfield.	"	221	87	Van Deusenville.	"	
36	Greenfield.	"	181	89	Housatonic.	4 a. Quartzite.	
43	Bernardston. ²⁹	} and d.	259	91	Glendale.	" and 4 b.	
50	South Vernon.	3 c. and 3 d.		93	Stockbridge.	4 b. Limestone.	
New Haven and Northampton Railroad.				99	Lee. ³⁰	"	
47	Granby.	16. Triassic.		102	Lenox.	"	
55	Southwick.	"	242	106	Deweys.	"	
61	Westfield.	"	147	110	Pittsfield.	"	1012
68	Southampton.	"	195	87	Van Deusenville.	4 b. Limestone.	
72	Easthampton.	"	169	95	W. Stockbridge.	"	
77	Northampton.	" and 3 a.	125	98	State Line.	4 c. Taconian Schists.	

30. The Taconic limestone is here a beautiful white marble, and it is extensively quarried. Less important quarries, worked for lime or marble, occur the entire length of the Berkshire Valley.

31. Amesbury. This and the adjoining towns, also the immediate city of Boston, are chiefly occupied by a profusion of lenticular-shaped drift hills, believed to be moraines of ancient glaciers, and different from the usual ground moraine of glacial drift. The hills may be two hundred feet high, and their longer axes run southeasterly, being parallel with the course of the striae in the neighborhood. They consist of till, and resemble the drumlins of Scotland. They also occur conspicuously in southern New Hampshire, and other parts of New England, and in western New York. In the Merrimack and Connecticut Valleys a few have been found having a direction to the south and west of south, but agreeing with the course of adjoining striae.

32. Plymouth. This township is said to contain three hundred and fifty-six ponds. These lie in hollows of the drift.

33. Wood's Holl. The extreme terminal moraine of the ice-sheet, which constitutes the "backbone" of Long Island, also Block Island, and the hilly part of Martha's Vineyard, from Gay Head to Vineyard Haven. It also appears at Chappaquiddick and Tuckernuck Islands, and forms Saul's Hills and Sankaty Head on Nantucket. A second terminal moraine, five to fifteen miles north from the foregoing, extends on the north shore of Long Island, from Port Jefferson to Orient Point, forms Plum and Fisher's Islands, reaches along the south shore of Rhode Island, from Watch Hill nearly to Point Judith, forms the chain of Elizabeth Islands, and continues on the peninsula of Cape Cod, from Wood's Holl to North Sandwich, and thence east to Orleans.

The portions of Martha's Vineyard, Nantucket, and Cape Cod, south of these moraines, and also Eastham, Wellfleet, and Truro, are modified drift.

Manomet Hill, east of Plymouth, is a moraine connected with that of Cape Cod and the Elizabeth Islands.

34. The numbers attached to the Norian, Huronian, Montalban, and Taconian, and their subdivisions, are used for convenience in this chapter; they only apply to Massachusetts, and are not intended to indicate correlation with formations similarly numbered in other parts of the book.

Notes 31, 32, and 33 are by Prof. Warren Upham; and 28 and 29 are by Prof. C. H. Hitchcock, from the first edition.

This blank space is intended for additional geological notes in pencil by the traveler.

New York.

By JAMES MACFARLANE.¹

GEOLOGICAL FORMATIONS OF THE STATE OF NEW YORK.*

FORMATIONS AND SUB-DIVISIONS.		FORMATIONS AND SUB-DIVISIONS.	
Devonian.	20. Quaternary.	Upper Silurian.	7. Lower Helderberg.* 6. Waterlime. 6. Salina or Onondaga Salt group. 5 c. Niagara. 5 b. Clinton. 5 a. Medina, { 2. Medina Sandstone. 1. Oneida Conglom.
	16. Triassic.		
	12. Catskill. 11 b. Chemung.		
	11 a. Portage, { 3. Portage s. s. 2. Gardeau shales. 1. Chasqua shales.		
	10 c. Genesee.		
	10 b. Hamilton, { 3. Tully Limestone. 2. Moscow shales. 1. Hamilton shales.	Lower Silurian or Ordovician.	4 c. Hudson River, { 3. Lor. sha. sh. & s. s. 4 b. Utica. 4 a. Trenton, { 3. Trenton l. s. 1. Black River l. s. 1. Birdseye l. s.
	10 a. Marcellus.		
	9 c. U. Held'berg or Corniferous, { 4. Seneca l. s. 3. Corniferous l. s. 2. Onond. a. l. s. 1. Schoharie.		3 b. Chazy. 3 a. Calciferous.
	9 a. Cauda Galli. 3 Oriskany.		2 b. Potsdam = dicelloccephalus beds. 2 a. Acadian = paradoxides beds. [Note 2 2 d. Georgian = olenellus beds.
		Cambrian.	
		Archaean.	1 d. Montalban. 1 c. Norlan. 1 a. Laurentian.

*Consisting in the ascending order of: 1, the Tentaculite limestone; 2 Pentamerus limestone; 3, Delthyris shaly limestone; 4, Encrinural limestone; and 5 Upper Pentamerus limestone.

GENERAL NOTE. The State of New York is to the geologist what the Holy Land is to the Christian, and the works of her Palæontologist are the Old Testament Scriptures of the science. It is a Laurentian, Cambrian, Silurian and Devonian State, containing all the groups and all the formations of these long ages, beautifully developed in belts running nearly across the State in an east and west direction, lying undisturbed as originally laid down. Railroads running north and south pass over a number of the formations in short distances, while those running east and west run for long distances on the same formation, as for example the N. Y. C. & H. R. R. on the 6. Salina, and the Erie Railway on the 11 b. Chemung. In the eastern part of the State the formations are more irregularly disposed. New York localities are those to which we must always go back as the standard by which any disputed formation of these ages is to be tested.

1. The author has bestowed more of his own labor and research on the local geology of this State, than any other, having besides diligent study of all the official reports, made personal observations of the exposures of the formations in traveling for many years on all the railroads. It was from making geological notes on the margin of railroad time tables that he conceived the idea of this geological railway guide book for the State, and by calling in the aid of scientific gentlemen of other States, he has been enabled to extend it over the whole United States and Canada. To Prof. James Hall, of Albany, the State Geologist, he is indebted for much information as to some of the localities in this State. [Note to first edition.] In revising this chapter the editor has made changes in the first edition only where recent investigations have rendered them necessary. In the revision he has been advised by the gentlemen whose names appear as authority for new lines and new notes and especially by Prof. W. B. Dwight of Vassar College. When no authority is given for any portion of the chapter, it will be understood that it has been taken from the first edition. J. R. M.

2. The table here given is not satisfactory to all of the contributors to this chapter, but, where terms are used by them in a different sense, the change is indicated by the number or otherwise. The Cambrian, as given in the table, is also divided into Lower (2 a), Middle (2 a.) and Upper (2 b.). In the first edition "Cambrian" included 2 b.—4 c. and was divided into Lower (2 b.), Middle (3 a., 3 b. (Quebec), and 3 c. (Chazy)), and Upper (4 a., 4 b., and 4 c.) J. R. M.

3. N. Y. C. & H. R. R. GRADES CAUSED BY GEOLOGICAL STRUCTURE.—This railroad undoubtedly occupies the finest locality for an east and west railroad in the United States. It owes this to geological structure, the outcrop of the formations running east and west, and the Salina or Onondaga, Utica and Hudson River soft shales are cut into low valleys through which the railroad and Erie Canal are built. If the formations had run north and south, as they do in Pennsylvania, Maryland, etc.,

New York Central and Hudson River Railroad. ¹			New York Central and Hudson River Railroad.—Continued.		
Ms.		Alt.	Ms.		Alt.
0	New York. ¹⁷⁸	See Note 4.	84	Croton.	1 a. Laurentian. 23 ms.
11	Spuytten Duyvil.	1 a. Laurentian.	87	Crugetts.	"
12	Riverdale. ⁵	"	88	Montrose. ⁶	"
13	Mt. St. Vincent.	"	41	Peekskill.	"
15	Yonkers.	"	45	{ Ft. Montgomery.	"
19	Hastings.	"	49	{ Highlands.	"
20	Dobb's Ferry.	"	49	{ Garrison's.	"
22	Irvington.	"	52	{ (West Point.)	"
25	Tarrytown.	"	52	Cold Spring.	"
29	Scarborough.	"	54	Cornwall. ⁶	"
30	Sing Sing. ⁵	"			

and been turned up edgewise, the hard sandstones would have been high ridges and perhaps mountains to overcome, as they are everywhere from the Mohawk Valley to Alabama. If even the limestone ridge of the Helderberg range, which bounds this valley on the south, had taken a northern direction, as the 2-4. formations do, a tunnel would probably have been necessary. In the western part of the State these Helderberg limestones continue, but not as a prominent ridge. The road via Geneva, runs on them at Auburn, Clifton Springs, etc., but with less favorable grade than the direct road, and at Buffalo they are level with the plain. It should be added that the old Laurentian mountains at Little Falls and at Peekskill have been cloven from top to bottom, thus opening the gateways for the traffic and travel of the West. The popular impression that New York is a level plain like the prairies of the West, derived from travelling on the N. Y. C. & H. R. R. R. is altogether erroneous. There is only a narrow trough through the centre of the State, in which the railroad and canal are located, that is of this level character.

4. New York island is 12 miles long and nearly two miles wide. The widest point is two and one-quarter miles at 14th St. Below Grand street it gradually becomes narrower as well as at the north end. The lower part of the city, below Wall street, is half a mile wide. The rock of the island is gneiss, except a portion of the north end, which is limestone. The south portion is covered with deep alluvial deposits, which in some places are more than 100 feet in depth. The natural outcropping of the gneiss appeared on the surface about 16th street, on the east side of the city, and ran diagonally across to 31st street on 10th Avenue. North of this much of the surface was naked rock. It contains a large portion of mica, a small proportion of quartz and still less feldspar, but generally an abundance of iron pyrites in very minute crystals, which, on exposure, are decomposed. In consequence of these ingredients it soon disintegrates on exposure, rendering it unfit for the purposes of building. The erection of a great city, for which this island furnishes a noble site, has very greatly changed its natural condition.

Dr. Hunt claims that the New York gneiss is in great part of Montalban age (1 d.) and the same with that of Philadelphia, Baltimore and Washington, and that it rests upon the Laurentian gneiss of the Highlands, which he says is the surface rock in the northern part of the island, but Dr. J. D. Dana thinks it extremely probable that the limestone and *conformably* associated rocks of Westchester County and New York Island, as well as those of the Green Mountain region from Vermont to New York Island, are metamorphosed Lower Silurian (including Cambrian) strata. J. M. M.

5. On the opposite side of the river may here be seen for many miles the Palisades, a long, rough mountain ridge close to the water's edge. Its upper half is a perpendicular precipice of bare rock of columnar structure from 100 to 200 feet in height, the whole height of the mountain being generally from 400 to 600 feet, and the highest point in the range opposite Sing Sing 1,011 feet above the Hudson, known as the High Torn. The width of the mountain is from a half mile to a mile and a half, the western slope being quite gentle. In length it extends from Bergen Point below Jersey City to Haverstraw, and then westward in all 48 miles, the southern portion being merely a low ridge. The lower half of the ridge on the river side, is a sloping mound of detritus, of loose stones which has accumulated at the base of the cliff, being derived from its weathered and wasted surface. This talus and the summit of the mountain are covered with trees, with the bare rocky precipice called the Palisades between. Viewed from the railroad or from a steamboat on the river, this lofty mural precipice with its huge weathered masses of upright columns of bare rock, presenting a long, straight, unbroken ridge overlooking the beautiful Hudson River, is certainly extremely picturesque. Thousands of travelers gaze at it daily without knowing what it is. J. M.

This ridge consists of a great sheet of basalt lying upon 16. Triassic sandstone, shales and conglomerates, which are often exposed along the river bank extending up the face of the ridge often for a considerable distance to an irregular contact with the igneous rock. It has been found that the trap has come from below as a dike through a long rent or fissure and then extended eastward by intrusion between the layers of sedimentary rock. Subsequent erosion has removed the overlying strata near the crest line and for some distance back but at many points along the western side of the ridge, the dike structure and relations to the overlying strata are finely exposed. See Notes 145 and 134. N. H. DARTON.

(See description of the 16. Triassic formation and its Trap Dikes.) Here is a remarkable but not uncommon instance of a great geological blank. On the east side of this river the formations belong either to the Archæan and oldest rocks, or to the Cambro-Lower Silurian, metamorphosed, while on the west side they are No. 16. all the intermediate Silurian, Devonian and Carboniferous formations being wanting. This state of things continues all along the Atlantic coast to Georgia, the 18. Cretaceous or 17. Jurassic taking the place of the 16. Triassic farther south. J. M.

6. 38 Montrose to 54 Cornwall. This celebrated passage of the Hudson through the Highlands, is a gorge nearly 20 miles long from 3 miles south of Peekskill to Fishkill, and is worn out of the 1 a. Laurentian rocks far below mean tide water. The hills on its sides rise in some instances as much as 2,600 feet, and in many places the walls are very precipitous. The rock is gneiss, of a kind that is not easily disintegrated or eroded, nor is there any evidence of any convulsive movement.

New York Central & Hudson River Rail- road.—Continued.			New York Central & Hudson River Rail- road.—Continued.		
Ms.		Alt.	Ms.		Alt.
57	Dutchess and Columbia Junction. ⁷	4 c. Hud. Riv. Group.	142	Albany. ^{10, 121}	4 c. Hudson Riv., 27 m.
58	Fishkill.	"	145	West Albany. ¹¹	" 196
62	Low Point.	"	160	Schenectady. ¹²²	4 b. Utica, 246
64	New Hamb'g. ¹¹⁸	Calceiferous-Trenton.	169	Hoffman's Ferry.	4 b. Utica, 7 miles. 266
69	Camelot.	4 c. Hud. Riv. Gr'p. ¹²⁹	174	Crane's Village.	" 270
73	Poughke'psie. ¹¹⁹	"	176	Amsterdam. ¹²	4 a. Trent. 10 ms. 279
78	Hyde Park.	"	182	Tribes Hill. ¹¹⁷	" quar. 1 m. 285
83	Staatsburg.	"	187	Fonda. ¹³	4 b. Utica, 5 miles. 299
88	Rhinebeck.	4c.&H.R. 2a.&2b. Cam.	192	Yost's. ¹⁴	{ Two bluffs or noses of Calc. on Laur. 300
94	Barrytown.	"	195	Spraker's. ¹⁴	{ 3 a. Calc. hill. Laur'n at R. R. track. 301
98	Tivoli.	"	198	Palatine Bridge.	{ 4 a. Trent. 3 ms. 304 Hills to north Calcif.
104	Germantown.	"	200	Fort Plain. ^{15, 180}	{ 4 a. Trenton, 18 ms. and Hud'n Riv. 305
107	Livington.	"	206	St. Johnsville. ¹⁸⁰	" 319
109	Catskill.	"	209	East Creek.	" 324
114	Hudson. ⁹	4 b. Utica.	216	Little Falls. ¹⁷	1 a. Lauren'an, 1 m. 376
118	Stockport.	2 a. Cambrian.	223	Herkimer. ¹⁸⁰	4 b. Utica, 28 miles. 393
121	Coxsackie.	"	225	Ilion.	" 400
123	Stuyvesant.	4 c. H'd. R. & 2 a. Cam.	227	Frankfort.	" 402
129	Schoadack. ^{8, 120}	"	237	Utica. ¹⁸	" 410
133	Castleton.	4 c. Hudson River. 19	241	Whitesboro. ¹⁹	" 415
142	East Albany.	" 23	244	Oriskany. ²⁰	4 c. Hud. Riv. 8 m. 423
142	Albany. ^{10, 121}	" 30			
148	Troy. ^{7, 10}	4 c. Hud. R. & 2 a. Cam.			

It is clearly a case of erosion, but not by the present river, which has but very slight fall in crossing them to join tide water near Peekskill. This therefore was probably a work mainly performed in some past period when the continent was at a higher level. Most likely it is a valley of great antiquity. Also see note 17.

7. From Dutchess Junction to Troy, revised by Prof. W. B. Dwight, from Rhinebeck to Troy the stratigraphy being given on the authority of Mr. S. W. Ford, except that his nomenclature has been modified so as to harmonize with that adopted in this chapter.

8. *Schoadack*. A series of great dislocations with upthrows on the east side traverse eastern North America from Canada to Alabama. One of these great faults has been traced from near the mouth of the St. Lawrence River, keeping mostly under the water up to Quebec just north of the fortress, thence by a gently curving line to Lake Champlain or through Western Vermont across Washington and Rensselaer Counties into Columbia County. The line of faulting has been recently traced southward to Schoadack Landing and to the south of Poughkeepsie and is supposed to run in to another series of faults, probably of a later date, which extend as far as Alabama. It brings up the rocks of the 2 b. Potsdam group in Vermont and New York on the east side of the fracture to the level of the 4 c. Hudson River and 4 a. Trenton l. s. on the west. In some places the Trenton appears on the east.

This fault is met with, a little more than half a mile east of Troy along the line of Jacob street. The rocks upon its eastern side (Potsdam) there hold an interesting fauna. From that point the fault takes a somewhat irregular course, being nearly two miles inland from the Hudson at Greenbush, and comes out upon the Hudson about a mile and a half south of Schoadack landing. S. W. F.

9. *Catskill Mountains*. For many miles on this railroad are beautiful views of the Catskill Mountains, 3,000 feet high, (12. Catskill), several miles distant on the opposite or west side of the river and which furnish the name for the Catskill formation. The wide valley between them and the river is composed of 11 b. Chemung, 10. Hamilton, 7. Lower Helderberg and 4 c. Hudson River. The geology on the east or railroad side is entirely different.

10. *Albany*. The clay beds at Albany are more than 100 feet thick, and between that city and Schenectady they are underlain by a bed of sand that is in some places more than 50 feet thick. There is an old glacial clay and boulder drift below the gravel at Albany, but Professor Hall says "it is not the estuary stratified clay. At the south end of the city of Troy the gravel and sand beds are subject to dangerous land slides. See also Note 121.

11. The distant mountain to the southwest is the Helderberg range. See notes 24 and 41.

12. *Amsterdam*. Precipice of 4 a. Trenton limestone back of the town, and quarries at the track. For 40 miles to Little Falls the railroad runs on Trenton limestone 3 a. Calceiferous, 4 b. Utica and 4 c. Hudson River irregularly alternating. See also Note 180.

13. Branch railroad north to Johnstown and Gloversville, in a valley of Utica slate.

14. Between Fonda and Palatine Bridge are fine bluffs of 3 a. Calceiferous. The talus of fragments of rock at the foot of the precipice whiten out in weathering like the stones about an old lime-kiln. It is from the cavities of the Calceiferous that the beautiful quartz crystals are produced, of which great quantities have been found. A similar bluff on south side of river. No Potsdam here.

15. The railroad skirts along the base of a ridge of Trenton limestone here and at Fort Plain.

16. At Fort Plain village the transition from the Birdseye to the Trenton limestone is to be seen, the first layers of the latter being of a drab color.

17. At Little Falls for one mile is a rare opportunity of seeing the 1 a. Laurentian formation, being a gorge cut by the Mohawk River through a spur of the Adirondack Mountain, which here crosses the railroad. You are now on the bottom rocks of the geological series, for nothing older

New York Central & Hudson River Rail- road.—Continued.			Alt.	New York Central & Hudson River Rail- road.—Continued.			Alt.
251	Rome. ²¹	448.4		c. Hudson River.			
255	Green's Corn. ²²	467.4		5 a. Medina, 2 ms. ⁴⁶⁶			
259	Verona. ²³	467.4		b. Clinton 9 miles.			
264	Oneida. ²⁴	440.4		c. Niagara. 3 miles.			
266	Wampsville. ²⁵			"			
				6. Salina or Onondaga Salt group,			
269	Canastota. ²⁶	436		23 miles.			
				273 Canaseraga. ⁴¹⁸		6. Salina or Onondaga Salt group.	
				275 Chittenango.		"	417
				279 Kirkville.		"	431
				282 Manlius.		"	416
				289 Syracuse. ^{27, 181}		"	403

The railroad via Auburn is better than the direct road to Rochester for geological observation.

has ever been found beneath them. The scenery has suddenly changed, and nothing is seen but bare, weatherworn precipices of crystalline rocks, from which all the elements through all the ages, have failed to produce a soil, yet a certain strange interest is attached to them. The oldest picture in the world, the oldest statue or other work of art, would excite the greatest attention, yet what are these in antiquity compared with these grand old Laurentian rocks, the oldest formation and the oldest dry land on the face of the earth, dating far back of the first appearance of either animal or vegetable life of any kind on our planet. The river channel through these rocks is an unequivocal example of river erosion, as pot-holes are found at various heights. See also notes 6 and 56.

18. *Utica.* The 4 b. Utica slate was named from this city. To study the Trenton, Black River and Birdseye limestones at their original, historical localities, change cars at Utica and go up the Utica and Back River Railroad to Trenton Falls. (See the within guide for that railroad.) You can then go on to Watertown on these limestones. Return by the Rome, Watertown & Ogdensburg Railroad to Rome or Syracuse, examining the Lorraine shales at Adams and Pulaski.

19. From here to Syracuse there is no lock in the canal. This long level is 427 feet above tide.

20. *Oriskany.* The formation of this name, is not exposed here, but at Oriskany Falls on the D.L. & W. R. R. from which the name is derived. The best fossils of it are found east of Union Springs in Cayuga County. Along the part of the road east of Oriskany, the Utica shale forms the bottom of the valley. The south wall of the valley consists of the outcrops of the 4 c. Hudson River, 5 a. Oneida Conglomerate, 5 b. Clinton, the 6 Waterlime and 9. Upper Helderberg. See 191.

21. *Rome.* No more 2-4 formations west of this in New York. From Rome to Buffalo and from Lake Ontario south to the Pennsylvania line all the formations are 5-11 Silurian and Devonian, and they are finely displayed in numerous gorges, ravines, canons and precipices, very regularly disposed in belts of outcrop running east and west. The typical localities from which most of the formations were named, are situated in this district. It is all historical geological ground, and you can scarcely go amiss in looking for fossils.

22. West of Little Falls the lower formations pass abruptly to the north and cross under Lake Ontario into Canada. The 4 c. Hudson River first crosses the valley, and then the Oneida conglomerate. Other rock formations now appear between Rome and Oneida, which had no existence in the basin east of Little Falls. These are the 5 a. Medina and Clinton, which overlie the Oneida, and form all the south shore of Lake Ontario, and extend across Canada West. Also 5 c. Niagara and the 6. Salina or Onondaga salt group, on which the N. Y. C. & H. R. R. runs from Oneida nearly to Rochester. The non-existence of these extensive formations east of Little Falls (the 5 a. Medina, 5 b. Clinton, 5 c. Niagara and 6. Salina), which cover the best part of Western New York, must be owing to the two parts of the State being separated in these early ages by the old Laurentine ridge at Little Falls into separate basins, in which the rock-forming conditions were different.

23. *Verona.* The Clinton fossil iron ore crops out on the railroad, but not of a good quality.

24. *Oneida.* The prominent ridge bounding the valley on the south of Utica, Oneida and Syracuse, called Stockbridge Hill, Pompey Hill, Cazenovia Hill and Onondaga Hill, is the Helderberg range, a continuous mountain 800 feet high, forming the back-bone of the State, and composed at its base of the 6 Waterlime, of the Salina group, all the members of the 7. Lower Helderberg being wanting as well as the 8. Oriskany sandstone and other sandstones that separate the Lower and Upper Helderberg, except a mere trace. On the Waterlime rests the Onondaga limestone, the most valuable building stone, and above this the Corniferous. Over these three great limestone formations is always found the 10 a. Marcellus shales, the 10 b. Hamilton and the 10 c. Genesee, forming the fine fertile country extending south from this ridge. Still farther south is the 11 a. Portage with its glens, gorges and precipices, and 11 b. Chemung, extending to the Pennsylvania State line. The Oneida conglomerate, which is 30 or more feet thick in Herkimer and Oneida, gradually attenuates in going west, being a grey band, from 4 to 5 ft. thick at Rochester. It was named from Oneida County.

25. *Wampsville.* Numerous fragments of Niagara limestones are seen mixed with the soil, showing its existence underneath. The Niagara limestone and shales which, at Niagara, Lockport and Rochester are 150 ft. thick, thin out in going eastward, being only two or three ft. thick at Squoit Creek near Utica.

26. *Canastota.* Stop off and take the branch railroad to Cazenovia, rising 750 feet in 15 miles. Fine geological sections of 6. Salina with gypsum beds, 9 Upper Helderberg and 10 b. Hamilton. Magnificent view across Oneida Lake and a beautiful village and lake at Cazenovia.

27. *Syracuse.* Onondaga Lake, which is in sight and on the north side of the railroad at the west end of Syracuse City, is 5 miles long, 1 mile wide; its greatest depth is 60 feet, and its surface is 363 feet above tide water. It is excavated in the red shale of the (6.) Salina formation. The lake is what remains of an ancient much more extensive and deeper excavation, all of which has been filled in with sand, gravel and rolled stones, except the part occupied by the lake. The bottom and sides of the lake are covered with lake marl six feet thick. The ancient excavation underneath answers an excellent purpose as a reservoir into which the salt waters are received and retained, and the marl of the bottom of the lake serves an equally good purpose by separating the fresh water of the lake from the salt water stored away in the basin or reservoir of sand and gravel beneath. There could be no better material for the purpose. Into this basin the various borings of the salt wells are made, not through

New York Central & Hudson River Rail- road.—Continued.			New York Central & Hudson River Rail- road.		
Ms.	Old Road, via Auburn.	Alt.	Ms.	Old Road, via Auburn—Continued.	Alt.
289	Syracuse. ²⁷	6. Salina, 9 miles. 408	346	Oaks Corners. ³¹	9 c. Cornif. l. s., 18 m.
298	Camillus.	"	349	Phelps.	"
300	Marcellus. ²⁸	" Gypsum beds.	353	Clifton Spr'gs. ⁴⁰	" 613
303	Half Way.	9 c. Upp. Helderberg,	358	Shortsville.	"
307	Skaneateles. ²⁹	or Cornifer. 14 m. 610	364	Canandaigua. ¹⁵⁷	10 Hamilton 6 ms. 740
310	Sennett.	"	368	Paddleford.	"
316	Auburn. ³⁰	" 715	369	Farmington.	"
		{ Quar. of Corn. l. s.	370	W. Farmington.	{ 9 c. Cornifer's l. s.
321	Aurelius.	6. Salina, 10 miles.			and Salina.
326	Cayuga. ⁷⁸	" (Lake. ²⁸⁸)	374	Victor. ¹⁸²	"
331	Seneca Falls.	9 c. Corn. l. s. 8 miles.	379	Fisher's. ¹⁸²	9 c. Salina 11 miles.
334	Waterloo.	9 c. Seneca limestone.	384	Pittsford.	"
		{ Deep drift overlying	388	Brighton.	5 c. Niagara, 4 miles.
341	Geneva. ³¹	{ 6. Salina and 9 c.	392	Rochester. ^{36, 137}	" 503
		Cornifer. l. s. 452			

or into rock, but only through the lake marl and other loose material mentioned, to a depth of 150 to 450 feet. No rock salt or bed of salt has ever been discovered in this State, although it has been in Canada; but in this Salina formation are twoporous or Vermicular masses of limestone, looking as if perforated by little worms, and hence the name; and between them are certain hopper shaped cavities in the shale in which, as well as in the perforations of these limestones, salt in a crystalline and solid state, it has been conjectured, formerly existed, the saline materials of which have been dissolved in water which percolated through the formation and passed into the basin where it is now found, the bed of marl on which is Onondaga Lake, being afterwards formed over it. But the origin of the salt water may be said to be at present unknown. Forty gallons of the brine produce a bushel of salt, weighing 60 pounds. These are the most productive salt wells in the world in so small a territory—two miles long and one-fourth of a mile wide.

28. Marcellus, from which the formation is named, is three miles south of this station.

29. Skaneateles. From the Junction with the N. Y. C. & H. R. R. the Skaneateles railroad runs south up the outlet of the lake of that name over the Corniferous limestone. The lake outlet with its falls, amounting to 463 feet to Jordan, affording excellent mill sites and many exposures of the rock. Before reaching Skaneateles Village the railroad passes over the Marcellus shales. Skaneateles Lake, where the railroad terminates, is 14 miles long, from a half to a mile and a half wide; its greatest depth south of Borodino is 320 feet and its surface 379 feet above tide. The sides of the northern end of this lake, at the beautiful village of Skaneateles, gradually slope to the water, corresponding in inclination to each other and adding greatly to the beauty of the lake. The water line, with the exception of the south part, is excavated in the Hamilton group. The south part of the lake is more narrow, and the banks rise abruptly to a considerable height above the water. The Tully limestone, at the top of the Hamilton, and over that of the Genesee slate, appear to the south of Borodino, rising, when first seen, 150 feet above the lake, and the south end or head of the lake is surrounded by the Portage group. Fossils along the lake. *Cyathophylloid* corals.

30. Auburn. The Corniferous member of the 9. Upper Helderberg limestone and the Onondaga limestone, which is its lower member, are extensively quarried at Auburn. The State Prison and the facings of many of the buildings of this handsome little city are entirely made of this limestone, and several fine churches are built of it. The formation ends at the main street where the 10 a. Marcellus shale begins, and it extends in the stream up to the outlet of the lake. Beginning below the city and following up the stream to the State Prison, the outlet exposes the following section: eight feet of the upper part of 6. the Waterlime of the Salina formation, one foot of 8. Oriskany sandstone, over eight feet of 9 c. Onondaga limestone and twenty-seven feet of the Corniferous exclusive of its upper member the Seneca limestone.

31. Geneva. The Seneca limestone of the upper part of the 9. Upper Helderberg disappears near Waterloo and reappears at a distance of six or seven miles west near Oaks Corners. The whole mass of limestone, and all the rocks north of it to Lake Ontario, have been removed from all the intermediate space, and along the shore of that lake the great depth of alluvium conceals the rock if any be present. Near Oaks Corners the limestone suddenly terminates as if broken off and removed, leaving an abrupt descent to the east which bears evidence of the erosive action of water. Seneca Lake and Lake Ontario probably originally communicated by this deep old channel. Ontario is 196 feet lower than Seneca. The same state of things seems to exist north of Cayuga Lake, where the drift material causes the Montezuma marshes and the shallowness of that lake at that end. Seneca Lake is 40 miles long, 3 miles wide, 530 feet deep, and its surface is 441 feet above tide water.

32. Jordan. Between Skaneateles Junction and Elbridge the Oriskany sandstone is over 30 feet thick, being at its maximum. At Auburn it is from six inches to two and a half feet thick.

33. Weedsport. At many points between Syracuse and Rochester, and on the Southern Central and other cross roads, are seen numerous hills or short ridges running from north to south, from fifty to one hundred feet high, with steep slopes and very sharp crests. These are not of drift or alluvium, as they appear to be, but are in reality outliers of the marly deposits of the Salina or Onondaga salt group, with only a thin covering of loose materials. Mount Hope at Rochester, the hill south of Brighton, Fort Hill Cemetery in Auburn, James street hill and University hill in Syracuse, and numerous hog-back ridges about Jordan and other places, are of this character, being Salina shales in place, spared when the adjoining valleys were eroded. There are, however, some hills composed of gravel, or a mixture of gravel and sand, but very little glacial drift on this R. R.

34. Great crops of peppermint are raised here, and this place supplies the world with peppermint oil. There seems to be some peculiarity in the soil which adapts it for the production of this plant.

New York Central & Hudson River Railroad.—Continued.			New York Central & Hudson River Railroad.		
Ms.	Direct Road.	Alt.	Ms.	Niagara Falls Division.—Continued.	Alt.
289 Syracuse. ^{27, 181}	{ 6. Salina or Ononda. Salt gr'p, 71 ms. ⁴⁰³	427	426 Lockport. ²⁸	600 5 c. Niagara, 10 miles.	521
299 Warner's.		427	430 Lockport Junc.	"	521
302 Memphis.		410	436 Hall's.	6. Salina, 12 miles.	521
307 Jordan. ²²		406	441 Tonawanda.	"	521
311 Weedsport. ²³		404	448 Black Rock. ⁴⁰	9 c. Corn. l. s. 4 ms. ⁵²¹	521
314 Port Byron.		408	449 Intern'l Bridge.	"	521
324 Savannah. ^{21, 78}		407	452 Buffalo. ⁴⁰	"	521
328 Clyde.		396	Direct Route.		
335 Lyons.		407	370 Rochester. ^{26, 187}	5 c. Niagara, 15 ms. ⁵²¹	521
340 Newark.		418	377 Coldwater.	"	521
348 Palmyra. ²⁴		428	381 Chili.	"	521
353 Macedon.		471	385 Churchville. ²⁷⁰	6. Salina, 17 miles.	521
360 Fairport.		456	388 Bergen.	"	521
366 Brighton. ²⁵	5 c. Niagara l. s. 10 ms.	508	391 West Bergen.	"	521
370 Rochester. ^{26, 187}	"	508	395 Byron.	"	521
Niagara Falls Division.			402 Batavia. ⁴¹	9 c. Corniferous, 8 ms.	521
370 Rochester. ^{26, 187}	5 c. Niaga., 10 ms.	508	408 Crofts.	10 b. Hamilton, 18 ms.	521
380 Spencerport. ²⁸⁰	5 b. Clinton, 12 miles.	508	414 Corfu.	"	521
383 Adams Basin.	{ Railroad runs be- tween Clinton and Medina.	546	418 Crittenden.	9 c. Cornif.	521
			421 Wende.	9 c. Cornifer., 20 ms.	521
389 Brockport.	"	546	428 Town Line.	"	521
392 Holley.	5 a. Medina, 23 miles.	568	428 Lancaster.	"	521
396 Murray.	"	547	438 Buffalo. ⁴⁰	"	521
481 Albion.	"	545	Buffalo and Niagara Falls Division.		
407 Knowlesville.	"	521	0 Buffalo.	9 c. Cornif. l. s. 5 ms.	521
411 Medina. ²⁷	"	545	3 Intern'l Bridge.	"	521
415 Middleport.	5 b. Clinton, 4 miles.	521	5 Black Rock. ⁴⁰	"	521
420 Gasport.	"	500	11 Tonawanda.	6. Salina, 15 miles. ⁵²¹	521
426 Lockport. ²⁸	5 c. Niaga., 21 ms.	500	17 La Salle.	"	521
437 Sanborn.	"	580	22 Niagara Falls. ²⁹	5 c. Niag. 4 miles. ⁵²¹	521
446 Suspens. Bridge	"	574	24 Suspens. Bridge.	"	521
447 Niagara Falls. ²⁹	"	574	30 Lewiston. ⁴²	{ 5 b. Clinton, 5 a. Medina. Lake, 245.	521

35. *Irondequoit*. A few miles east of the mouth of the Genesee River, the Irondequoit Creek empties into the lake, flowing in a deeper channel than the Genesee, but through deposits of sand and gravel. Professor Hall suggests with much probability that the Genesee ran in the channel of the Irondequoit, but when that was filled with gravel and the region elevated, the Genesee was turned westward and compelled to cut its present rocky bed like the Niagara. This phenomenon is not rare, but is many times repeated in this State. See notes 31, 38, 39 and 110.

36. *Rochester*. See Genesee Falls out of the car windows on the north side at the east end of the station house. The gulf of the Genesee River, from Rochester to Charlotte, is remarkable for the striking example of erosion which it exhibits. The distance is seven miles, in which the river forms three cataracts over three distinct formations, the Medina sandstone the lowest, 84 feet fall; the Clinton 25 feet one and three-fourth miles below, and the Niagara group 96 feet fall, close to the railroad bridge. It is evidently the different hardness of the groups or their varying facility of decomposition that have produced these falls. These three falls at first were but one, and at this time the lower ones are gaining probably on the upper one and the time may come when they will unite again.

37. The 5 a. Medina formation is named after this place. Layers filled with *Lingula* and *Leporellia*.

38. At Lockport is a repetition of the Rochester and Niagara Falls ravine in the Niagara limestone and shales here crossed by the railroad on a high bridge. Here too, a mile west of the city, you can see on the north side of the railroad an old, dry channel from which the stream was diverted by the drift, corresponding to the Irondequoit at Rochester and St. David's at Niagara Falls. There is another of these dry, old channels at Oak Orchard. Niagara fossils found here.

39. Niagara Falls are six and a half miles south from Lake Ontario at Lewiston, and the whole distance the river runs in a gulf, which, at the falls, is 160 feet, and at Lewiston, 300 feet deep and generally about twice as wide at the top as at the bottom. The rocks passed through by the receding falls are the Medina sandstone, the Clinton group of limestone and shale, and the Niagara limestone and shale. These rocks have a slight southerly dip, and all except the Niagara group have disappeared beneath the bed of the river, the falls being now in the Niagara group entirely, the shale lying beneath the limestone. At the whirlpool, a little more than three miles below the falls, on the west bank of the river, the continuity of the rock forming the bank is interrupted by a deep ravine filled with drift material. This ravine may be traced two miles in a northwest direction, and from thence another depression can be followed to Lake Ontario at St. David's four miles west of Queens-town. When the ravine to St. David's was blocked up by drift materials the stream would be forced

New York Central & Hudson River Railroad.—Continued.		New York Central & Hudson River Railroad.—Continued.	
Ms. Canandaigua and Tonawanda Division. Alt.		Ms. Charlotte Branch. Alt.	
0 Canandaigua. ¹⁵⁷	10 b. Ham'n, 16 m. ⁷⁴⁰	370 Rochester. ^{36, 137}	{ 5 c. Niagara. ⁵⁰⁸ 5 b. Clinton.
8 East Bloomfield.	" ⁵⁸³	879 Charlotte. ²⁵	5 a. Med., (Lake, 245)
12 Miller's Cor's. ¹⁸³	" ⁵⁹⁶	Troy & Schenectady.	
15 West Bloomfield.	"	148 Troy.	Hud. Riv. & 2 b. Pots.
18 Honeoye Falls.	9 c. Cornifer. 2 ms. ⁷⁷⁷	151 Cohoes.	" Falls, 70 Feet.
25 West Rush.	6. Salina, 22 miles.	154 Crescent.	"
26 Erie R. R. Junc.	"	160 Niskayuna.	"
28 Maxwell's.	"	166 Aqueduct.	4 b. Utica.
33 Caledonia. ¹²⁵	" ⁶⁵³	170 Schenectady.	"
40 Le Roy. ¹²⁵	9 c. Cornif., 25 ms. ³⁷³	Skaneateles Railroad.²⁹	
44 Stafford.	" ⁵⁹⁴	Syracuse,	(As before.) ⁴⁰⁸
50 Batavia. ⁴¹	10 b. Hamilton. ⁵⁹⁵	0 Skaneateles Jc.	9 c. Corniferous. ⁵¹⁰
57 East Pembroke.	9 c. Corniferous. ⁵⁸⁵	8 Mottville.	10 a. Marcellus.
63 Richville.	" ⁵²⁸	4 Kellogg's Mills.	"
65 Falkirk.	" ⁵⁴³	5 Skaneateles. ²⁹	10 b. Hamilton. ⁵⁹⁰
67 Akron. ¹²⁵	" ⁷⁴⁵		
74 Clarence Centre.	6. Salina, 21 miles. ⁶⁴³		
77 Transit.	"		
80 Gettysville.	"		
86 Tonawanda.	" ⁵⁸⁰		

to find its present rocky channel. Even though the drift rose only a foot higher than the rocks it would as effectually force the water over the rocks as if it formed a mountain. Could the river have once surmounted the drift, its work would have been comparatively easy in wearing out a bed through the old ravine, but till it was able to flow over the barrier it would have no power over it, and must commence its slow work of wearing away the solid rock. The present gulf shows us what it has done since the drift period.

J. HALL and SIE CHARLES L'VELL.

40. At Black Rock there is only from 6 to 14 inches of the Onondaga limestone which is of a grayish color, crystalline and contains few fossils. The Corniferous limestone above it is 25 to 30 feet containing abundance of hornstone. It is dark colored, fine grained, and in its fresh fracture, and particularly when wet, it presents an almost black appearance, which has given the name of Black Rock to the place. It affords good quarries of excellent building stone. From the occurrence of the Corniferous along the south end of Lake Erie and its dip southward, it seems probable that the bed of this lake has never been excavated below it, and that it now forms the floor beneath the deposit of alluvium. It seems that there are others of the lake bottoms composed of limestone, especially Lake Ontario. See note 71. This is probably for the reason that it received a polish from the action of glaciers which then passed over it, while the resistance of the grit of the sandstones and shales was more favorable for deeper excavation. Lake Erie is 230 miles long, 50 miles wide, 140 feet deep and its surface is 569 feet above tide.

41. Batavia is the highest point on the N. Y. C. & H. R. R. R., and one of the highest in Western New York, being 895 feet above tide. This is caused by there crossing the 9 c. Helderberg formation, which maintains its elevation although not observable as a mountain range, being overcome by easy grades. Notice the elevations of the railroad crossings of the Helderberg and Hamilton range, although the railroad seeks the lowest points; Buffalo, 684; Batavia, 895; Le Roy, 872; Canandaigua, 740; Auburn, 715; Skaneateles, 890; Tully, 1249; Cazenovia, 1249; Cooperstown, 1193. When the valleys cut through the limestone, the summit is farther south on the Hamilton or Portage.

42. *Lewiston.* Tourists should not fail to go down to Lewiston, the terminus of the Buffalo and Niagara Falls division. This railroad ride, although little known, is one of the finest in the United States. It follows the bank of the Niagara River, affording admirable views of the rapids and the formations displayed in the gulf. Nowhere in the State are there better geological sections. On the Canada side, also the Canada Southern Railway, running to the mouth of the Niagara River at Niagara City, affords one good view of the falls, but no such remarkable sections of the rocks as on the American side, where the railroad overhangs the fearful torrent of the river for several miles.

43. *Knowersville.* The Helderberg mountain shows finely on the left or southwest side of the railroad opposite Guilderland and Knowersville. The railroad passes through it between that place and Duanesburgh. The mountain is capped by the 7. Lower Helderberg limestone forming a steep precipice along its summit, and this rests on the 4 c. Hudson River slates. Back of Knowersville two notches are cut out of the mountain by two streams, leaving a picturesque, fortress-like bluff of the limestone. The Helderberg formations are named from this mountain. See Note 158.

44. At Howe's Cave large quarries on the railroad track. Good place to examine Lower Helderberg limestone and to collect fossils. The cave is an old underground water channel, and it is several miles long. Notice that the limestone at Cobleskill is *Upper* Helderberg and that at Howe's Cave *Lower* Helderberg. On no other railroad can you see them both.

45. Cooperstown is seated at the south end of Otsego Lake on a dike of alluvium. This lake is a handsome sheet of water seven miles long, one and a half wide, 1193 feet above the ocean. It has a high ridge of the Hamilton group on the east side, a low and interrupted range of the same on the west side, and an elevated projection on the northeast end. This lake is one of the head waters of the Susquehanna, the valley spreading out to the southwest. See also 186.

46. *Sharon Springs.* All the large sulphur springs of the State, Avon, Clifton, Richfield, etc., and many small ones, rise from the waterlime. Glacial Striae here and at Cherry Valley.

47. *Cherry Valley.* The railroad is on Corniferous, but the cliffs and gorge are Waterlime, Lower Helderberg, Cauda Galli, and, slightly, Oriskany. Marcellus and Hamilton form the hills on the south.

Delaware & Hudson Canal Co's Railroads.			Delaware and Hudson Canal Company's Railroads.—Continued.			
Ms.	Albany and Susquehanna Railroad.	Alt.	Ms.	Middleburg and Schoharie, and Schoharie Valley Railroads.	Alt.	
0	Albany. ^{10, 121}	4 c. Hudson River. 20	0	Central Bridge or Schoharie Junction.	} 4 c. Hudson River.	
6	Adamsville.	" 212	3	Hollenbeck's. ⁴⁸		"
7	Slingerlands.	" 214	6	Schoh'e C. H. ⁴⁹		9 b. Schoharie grit. ¹¹⁰
11	New Scotland.	" 227	9	Borst's.		7. Lower Helderberg.
14	Guilderland. ¹⁵⁸	" 229	12	Middleburg.		10 a. Marcellus. ⁴⁴⁰
17	Knowersville. ⁴³	" 459				
24	Duanesburg. ⁷⁹³	" and Utica.				
27	Quaker Street.	"				
31	Esperance.	" 769				
36	Central Bridge.	7. L. Helderberg.				
39	Howe's Cave. ⁴⁴	" 782				
45	Cobleskill. 908	8. Oriskany. 9 c. U. Helderberg l. s. 10 a. Marcellus. 1173 " 10b. Ham. 10 b. Hamilton.				
50	Richmondville.					
57	East Worcester.					
62	Worcester. 1310					
67	Schenectus. 1272					
70	Maryland. 1220					
75	{ Cooperstown Junction. ⁴⁵					
76	Colliers.					
79	Emmons.					
82	Oneonta.					
90	Otego.					
95	Wells Bridge.					
99	Unadilla. ¹⁸⁴					
103	Sidney. 990					
108	Bainbridge.					
114	Afton.					
119	Nineveh.					
127	Tunnel.					
132	Osborn Hollow.					
134	Port Crane.					
142	Binghamton. ¹⁸⁵					
	Saratoga. 265	{ 3 a. Calciferous and 4 a. Trenton. 304				
0	Ballston. 310	4 c. Hudson River. 248				
15	Schenectady.	"				
29	Quaker Street.	"				
45	Cobleskill. 908	9 c. Upper Helderberg.				
50	Hyndsville.	" 1112				
54	Seward.	" 1177				
59	Sharon Spr'gs. ⁴⁶	7. Low. Helderb. 1253				
68	Cherry Valley. ⁴⁷	9 c. Corn. & Marc. 1321				
Cooperstown and Susquehanna Valley R. R.						
75	Junction.	11 a. Portage.				
91	Cooperstown. ⁴⁵	10 b. Hamilton. 1193				

119	Nineveh.	11 b. Chemung. 1092
122	Centre Village.	" 964
127	Ouaquaga.	" 991
130	Windsor.	"
138	Comstock.	"
140	Jefferson Junc.	"

Saratoga and Champlain Division.		
0	Albany.^{10, 121}	4 c. Hudson River. 16
6	West Troy.	"
9	Cohoes.⁵⁰	" Falls 70 ft.
12	Albany Junction.	"
0	Troy.	" 28
6	Albany Junc.	"
12	Mechanicsville.	"
25	Ballston.	" 310
32	Saratoga. 265	4 a. Trenton & Calcif.
43	Gansevoorts.	"
49	Fort Edward.	" 141
57	Smith's Basin.	" quarries.
60	Fort Ann.	"
64	Comstock's.	{ 2 b. Potsdam. Fine surface exposures for 4 miles.
71	White Hall.¹⁷⁹	{ 2 b. Potsdam. Fine expos'rs on 1 a. Laurentian gneiss. 113
0	White Hall.⁵¹	" Lake. 98
7	Chubb's Dock.	3 a. Calciferous.
10	Dresden.⁵²	" & 1 a. Laur. back.
14	Putnam.	1 a. Laurentian. 515
		"
20	Pattuiwa. (Mt. Defiance.)	3 a. Calciferous bluff.
22	Ft. Ticonderoga. (Ticon'ga Creek, outlet of Lake George.)	4 a. Trenton. Valley.
		1 a. Laurentian.
		"
24	Addison Junc.	4 a. Trenton. " large valley.

48. On either side of the valley, according to Prof. Hall, is the following section: Pyritiferous shales, (Clinton group); Coralline limestone, (Niagara); Waterlime, (Salina); Tentaoulite; Pentamerus; Delthyris shaly limestone; Upper Pentamerus, (Lower Helderberg); Oriskany; Cauda Galli; Schoharie grit; Onondaga limestone, (Upper Helderberg). At Hollenbeck's are cliffs of Hamilton, "Vroman's Nose."

49. The Schoharie grit formation was named from this place. The fossils peculiar to it are found in the mountain one and a half miles northwest and northeast of Schoharie. See note 159.

50. See from car windows the great falls of Mohawk, 70 feet high, over Hudson River slate.

51. White Hall is usually called the head of Lake Champlain, but the lake for 15 miles is rarely more than 100 to 150 yards wide. It is in fact a mere channel between mud flats and clayey alluvium. Lake Champlain is 112 miles long, 600 feet deep, and the surface being only 96 feet above tide, it

**Delaware and Hudson Canal Company's
Railroads.—Con.**

Ms. Saratoga and Champlain Division.—Con. Alt.

82	Crown Point.	1 a. Laurentian bluff. 4 a. Trenton.
40	Port Henry. ⁵³ (Tunnel.)	1 a. Laurentian bluff. 4 a. Trenton, 7 miles. Val'y chiefly 1 a. Laur.
51	Westport. ⁵⁴	1 a. Laurentian.
64	Wadham's Mills.	"
57	Whallonsb'gh. ⁵⁵	"
64	Willsborough. ⁵⁵	{ For 13 miles deep cuts through bluffs, 1 a. Laur'n. Beau- tiful sections.
77	Port Kent. ⁵⁶ (Ausable R.) ⁵⁷	1 a. Laurentian ends. 2 b. Potsdam.
84	Valcour.	{ 2 b. Pots'm. Heavy beds of sand & clay.
90	Plattsburg.	" 119
95	Beekmantown.	{ 4 a. Trenton and 8 b. Chazy.
99	West Chazy.	"
100	Chazy. ⁵⁸	"
105	Sciota.	"
111	Moore's Junc.	"
118	Champlain.	{ 3 a. Calciferous & 8 b. Chazy.
99	West Chazy.	"
122	Rouse's Pnt. ¹⁹⁹ (Con. in Canada, see Grand Trk. R'y.)	"

**Delaware and Hudson Canal Company's
Railroads.—Con.**

Ms. Ausable Branch. Alt.

0	Plattsburg.	2 b. Potsdam. 119
5	Salmon River.	3 a. Calciferous.
8	Laphams Mills.	1 a. Laurentian.
10	Peru.	"
14	Harkness.	"
17	Ferronia.	"
20	Ausable. ⁵⁷	"
Glens Falls Branch.		
49	Fort Edward.	4 a. Trenton. 141
53	Sandy Hill.	"
55	Glens Falls.	" Utica sl. above.
Lake George Branch.		
22	Ticonderoga.	1 a. Laurentian.
26	Baldwin on Lake George. ⁵⁹	"
Rutland and Washington Division. 164		
0	Rutland, Vt.	Calciferous-Trenton.
4	W. "	" & 4 c. H. R.
10	Castleton, Vt.	2 Lower Cambrian.
14	Poultney, Vt.	"
21	Middle Granville	" & 4 c. H. R.
28	Granvi'e, N.Y. ¹⁴⁰	4 c. Hudson River.
30	W. Pawlet.	L. Camb. & 4 c. Hud. R.
37	Rupert, Vt.	2 Lower Cambrian.
45	Salem, N. Y.	"
52	Shushan.	2 L. Camb. & Hud. Riv.
56	Cambridge.	4 c. Hudson River.
62	Eagle Bridge. ¹⁴⁰	"

extends 500 feet below the level of the ocean. Its bed is a deep chasm in the Laurentian or Primitive rocks. On the west side, where the mountain ranges reach it, the slope is abrupt, but on the east side it is longer and more gradual. At many places the lake is bordered by steep banks of blue and yellowish brown clay and yellowish brown sand, rarely over 15 feet thick, but its greatest height is 100 feet at Burlington. It contains marine fossils in the mixture of clay and sand, but none in the clay beneath. This drift formation extends north to the mouth of the St. Lawrence River. In Albany County it is an immense mass and is known as the Albany clay.

52. From Dresden to Port Kent, 67 miles the Laurentian hills are the western boundary of the valley of Lake Champlain. But at many points this mountain ridge recedes from the lake, leaving nooks and valleys, in which are patches of 3 b. Chazy and 4 a. Trenton limestone along the railroad.

53. The magnetic iron ore mines back of Port Henry are worth a visit, the bed of the ore being more than 100 feet thick. The mining of these heavy beds is on a grand scale.

54. From 51 Westport to 77 Port Kent, the formation, according to Dr. Hunt, is 1 c. Norian or Upper Laurentian.

55. At the village of Essex, on the lake and between Whallonsburgh and Willsborough stations, is a bold bluff, 100 to 200 feet high above the lake, of 3 b. Chazy limestone.

56. The Adirondack Mountains commence at Little Falls, rising suddenly from the Mohawk Valley, and run northeast to Port Kent on Lake Champlain. The most elevated peak, Mount Marcy, is 5,467 feet high, the summit being just upon the region of perpetual frost. There are four other peaks 5,000 feet high, each distant about 6 miles from the other. This group of Adirondack Mountains is the culminating point of the State around the sources of the Hudson, Ausable, Racket and Black Rivers, and dividing the north half of the State into two separate geological basins. They are directly west of Westport, several miles to the west of the railroad. Only a glimpse of one of them can be had from the railroad. In the Adirondack pass in Essex County, is a perpendicular precipice or naked wall of rock 1,000 feet high and more than half a mile long. There is not probably in the Eastern States an object of the kind so vast and imposing as this. Emmons, 218.

57. Stop at Port Kent and visit the Ausable valley, which is interesting for the Ausable chasm, where for at least two miles the Ausable River, a large and rapid stream, is compelled to flow through a rocky gorge in the 2 b. Potsdam sandstone with perpendicular walls of 100 feet with a width only varying from 20 to 40 feet. Here the *lingula antiqua* is found in great abundance, and there is here a better development of the Lower Silurian or Cambrian rocks than in any other part of the State. Emmons, 287. *Lingula* and *trilobites* near foot of Cathedral rocks.

58. The 3 b. Chazy formation was named from this locality. Off line of R. R. are abundant Chazy fossils, *Maclura Rhynchonella*, etc. See Note 55. Also as to Isle La Motte see Note 67.

59. The rock which forms Diamond Island in Lake George is a good example of 3 a. Calciferous. Lake George is 30 miles long, 1½ miles wide, and its surface is about 80 feet above tide water.

Ma.	Adirondack Railroad.	Alt.	Ma.	Utica and Black River R. R.—Con. Alt.
0	Saratoga. ⁵⁰⁴	4 a. Trenton & 3 a. Cal.	25	East Steuben.
6	Greenfield.	2 b. Potsdam. ⁵⁰⁴	28	Alder Creek.
10	King's. ⁵⁰⁰	"	35	Boonville. ⁵⁰⁸
13	South Corinth.	"	38	Leyden.
17	Jessup's Landing.	"	42	Port Leyden.
22	Hadley. ⁵⁰⁰	1 a. Laurentian. ⁵⁰⁶	45	Lyons Falls. ⁵⁴⁴
30	Stony Creek.	"	51	Glendale.
36	Thurman.	"	54	Martinsburg. ⁶¹
44	The Glen.	"	58	Lowville.
47	Washbu'n's Eddy.	"	66	Castor Land.
50	Riverside.	"	70	Deer River.
58	North Creek.	"	74	Carthage. ⁶⁶
Chateaugay Railroad. ¹⁶⁴			81	Great Bend.
0	Plattsburg. ¹⁶¹	4 a. Trenton.	83	Felt's Mills.
8	Morrisonville.	2 b. Cambrian. (?)	85	Black River.
12	Cadyville.	"	92	Watertown. ⁶⁷
17	Dannemora.	1. Laurent. & 2. b. Cam.	104	Sacket's Harbor.
22	Saranac.	"	74	Carthage. ⁶⁶
34	Lyon Mt.	"	92	Theresa Junct.
Crown Point Iron Co's R. R.			98	Orleans Corners.
0	Crown Point.	1. Laurt. & 4 a. Trent.	101	Lafargeville.
13	Hammondville.	1. Laurentian.	108	Clayton.
Utica and Black River R. R.			74	Carthage. ⁶⁶
0	Utica.	4 b. Utica, 12 ms. ⁴⁴⁶	83	Sterlingsville.
6	Marcy.	"	87	Philadelphia.
10	Stittville.	"	90	Shurtliff's. ⁴¹⁶
12	Holland Patent.	4 a. Trenton, 32 ms. ⁶³⁰	93	Theresa Junct.
16	Trenton.	"	95	Theresa.
18	Trenton Falls. ⁶²	"	101	Redwood.
19	Prospect. ⁶²	"	108	Rossie. ³²⁶
21	Remsen.	"	118	Hammond.
		"	118	Briar Hill.
		"	123	Morristown. ²⁵¹

60. This railroad cuts through Trenton, Calciferous and Potsdam within less than 10 miles of Saratoga. Fine sections of ripple marked Potsdam in railroad cut in Greenfield. The Ausable chasm is repeated at the High Falls of the Hudson at Luzerne or Hadley station on the Adirondack Railroad, in Warren County, where the river flows for a mile through a gorge at the junction of the Potsdam sandstone and the gneiss. The walls rise in some places to a height of one hundred feet.

61. *Potsdam*. This is the locality which gave the name to the Potsdam sandstone. See the description of that formation in another part of this volume.

62. *Trenton Falls*. For about three miles between Trenton Falls station and Prospect station and a mile or two east of the railroad, the East Canada Creek has cut a passage through the Trenton limestone, the sides of the excavation rising vertically with an average height of over 100 feet. In this passage are the Trenton Falls or Cascades which have given so much celebrity to the place, justly meriting by their number, beauty and position, the admiration they receive. Including the one at Prospect Village there are six falls, five of which are placed at intervals somewhat regular and occupy the middle part of the excavation. The rock is in thin layers of from 6 to 10 inches in thickness, separated by thin layers of shale, and contains trilobites in prodigious numbers. The formation derives its name from this place. It is 500 feet thick and about seven miles in breadth. Going east or south it grows thinner and is about 30 feet thick in the Mohawk Valley. The stone quarried at Prospect and used at Utica, is the upper part of the Trenton, which is here of a gray color and of a more solid and crystalline structure and appearance. Going on north by this railroad you travel for many miles on a terrace of the limestones of this group, forming the banks of Black River, which has its rocky channel in this formation all the way to Watertown, with three important falls at Lyons, Carthage and Watertown and many cascades. Very picturesque scenery and interesting geology, with an abundance of fossils.

63. *Boonville*. The first range or cliff of limestone on Black River, extending by the side of the river from opposite Boonville to Watertown, is the Birdseye limestone. It is of a light dove color which by long exposure to the weather becomes of a light ash gray or white. It is in thick, straight layers, with straight, vertical joints, giving the rock when quarried the appearance of a wall, and it has a compact grain and smooth fracture.

64. At Lyons Falls, Black River falls 63½ feet over gneiss or 1 a. Laurentian rock. Thence to Carthage it falls but 9 feet and there is another fall over gneiss rock.

65. The high hills west of Martinsburg are of the Hudson River group.

Rome, Watertown and Ogdensburg Railroad.			Rome, Watertown & Ogdensburg R. R.—Con.		
Ms.		Alt.	Ms.	Syracuse Division.	Alt.
0 Rome.	445	4 c. Hudson River.	0 Syracuse. ²⁷	{ 6. Salina or Onondaga Salt group. ⁴⁰³	
11 Taberg.		" 11 miles.	5 Liverpool.	"	
14 McConnellsville.		{ 5 a. Medina and Oneida Conglomerate, 81 miles.	8 Woodward.	5 c. Niagara.	
18 Camden.		" 520	11 Clay.	5 b. Clinton.	
28 West Camden.		"	15 Brewerton. ¹⁰²	"	384
28 Williamstown.		" 604	18 Central Square.	5 a. Medina.	
31 Kasoag.		" 636	22 Mallory.	"	
37 Albion.		" 547	24 Hastings.	"	
42 Richland. ⁶⁸		"	27 Parish.	"	474
47 Sandy Creek. ⁵⁵⁹	4 c. Hudson R. 12 ms.		31 Union Square.	4 c. Hudson River.	
52 Mannsville. ⁷²⁵	" Lora. shales.		34 Holmesville.	"	320
54 Pierrep't Manor.	" deep gulfs.		39 Pulaski. ⁷⁰	"	377
59 Adams. ⁵⁹	4 a. Trenton limestone.		45 Sandy Creek Ju.	"	359
63 Adams Centre.	"	619	Lake Ontario Division, West.		
72 Watertown Junc.	Tren., Birdseye and Black Riv. drift.	403	0 Oswego. ⁷¹	280	5 a. Medina. Lake, 245.
73 Watertown. ⁶⁷	"	435	4 Furniss.	"	
78 Sanford's Corners	3 a. Calciferous.	485	7 Wheeler's.	"	
83 Evan's Mills.	2 b. Potsdam.		10 Hannibal.	5 b. Clinton.	
90 Philadelphia.	1 a. Laure'n, Iron ore.		13 Sterling Valley.	"	
96 Antwerp.	"		16 Sterling.	"	
101 Keene's.	2 b. Potsdam.		20 Red Creek.	"	525
108 Gouverneur.	1 a. Laurentian.		26 Wolcott.	360	" Fossil iron ore.
115 Richville. ⁸²⁸	" Iron ore.		31 Rose.	"	
123 De Kalb Junc.	2 b. Potsdam.		36 Alton.	"	
129 Rensselaer Falls.	3 a. Calciferous.	248	38 Wallington.	"	
134 Heuvelton.	5 a. Medina.		41 Sodus.	"	480
142 Ogdensburg.	4 c. Hudson River.	377	47 Williamson.	"	604
42 Richland. ⁶⁸	5 a. Medina.	318	52 Ontario.	415	" Fossil iron ore.
47 Pulaski. ⁷⁰	"	375	56 Union Hill.	"	"
50 Sandhill.	"	306	59 Webster.	"	
55 Mexico.	"		64 Pierce's.	"	
60 New Haven.	"		66 Sea Breeze. ³⁵	5 a. Medina.	
63 Scriba.	"		70 Charlotte. ³⁶	"	255
71 Oswego. ⁷¹	280	" Lake, 245	76 Greece.	"	
73 Watertown. ⁶⁷	4 a. Trenton.	455	80 North Parma.	"	
72 Watertown Junc.	"	403	83 East Hamlin.	"	
76 Brownville. ⁷²	"	294	86 Hamlin.	"	310
86 Chaumont.	"		90 East Kendall.	"	
89 Three-Mile Bay.	"		92 Kendall.	"	
93 Rosiere.	"		97 East Carlton.	"	
97 Cape Vincent.	"	253	100 Carlton.	"	
123 De Kalb Junc.	1 a. Laurentian.		103 Waterport.	"	349
131 Canton.	2 b. Potsdam.		106 Carlyon.	"	
142 Potsdam. ⁶¹	"		110 Lyndonville.	"	
148 Potsdam Junc.	3 a. Calciferous.		114 County Line.	"	
			118 Somerset.	"	332
			123 Hess Road.	"	
			127 Newfane.	"	
			128 Coomer Road.	"	
			132 Wilson.	"	300
			147 Rawsonville.	"	
			156 Lewiston. ⁴²	358	" Lake, 245.

66. The Laurentian rocks cover the whole of the country east of the Black River and the later formations west of the river, the opposite sides forming the strongest contrast imaginable as to rocks, soil, vegetation and population.

67. At Watertown the banks of the Black River present fine sections of the limestone visible from the car windows, showing the Trenton limestone, Black River limestone and the Birdseye limestone. There is a mass forming the Black River sub-division, known to quarrymen as the seven feet tier, lying between the Birdseye and Trenton limestone. At the Isle LaMotte, near Chazy, in Lake Champlain, it is a black marble, but at Watertown it is only suitable for ordinary purposes.

Delaware, Lackawanna and Western Railroad.—Con.			Del., Lack. & Western R. R.—Con.		
Ms.	Binghamton to Buffalo.	Alt.	Ms.	Binghamton to Buffalo.—Con.	Alt.
207	Binghamton. ⁹⁰	863	380	Darien.	10 b. Hamilton. 878
215	Vestal.	828	387	Alden.	10 b. Ham. & 9 c. Corn.
221	Apalachin.	819	396	Lancaster.	9 c. Corniferous. 853
228	Owego. ¹⁸⁸	815	403	East Buffalo.	" 577
233	Lounsberry.	"	409	Buffalo. ⁹⁰	" 533
236	Nichols.	"	Northern Central Railroad.		
242	Litchfield.	"	0	Elmira. ¹⁰⁸	11 b. Chemung. 863
246	Waverly. ¹⁸⁸	826	6	Horse Heads.	865 " Valley drift.
250	Williwanna.	801	10	Pine Valley.	" " 865
	Lowmansville.	828	13	Millport.	11 a. Portage.
263	Elmira.	855	19	Havana. ^{85, 191}	" 447
267	Horseheads.	911	22	Watkins. ^{85, 194}	473 " Lake. ⁴⁴¹
272	Big Flats.	906	29	Rock Stream.	"
	Gibson.	"	31	Big Stream.	10 c. Genesee, Gulf.
278	Corning. ¹⁸⁸	929	33	Starkey.	" 810
281	Painted Post.	945	37	Himrod's.	" 799
284	Coopers.	"	41	Milo.	" 857
287	Curtis.	"	45	Penn Yan. ⁸⁷	756 " & Portage.
289	Campbells.	1015	49	Benton.	" " "
293	Savonia.	"	51	Bellona.	10 b. Hamilton. 868
298	Bath. ²⁰⁵	1101	55	Hall's.	" "
302	Kanona.	"	58	Stanley.	" 904
306	Avoca.	1193	61	Lewis.	" "
	Wallace.	1232	63	Hopewell.	" 850
314	Cohocton.	1287	69	Canandaigua. ⁸⁸	Lake, 668 " 740
319	Bloods.	1317	0	Sodus Point.	5 a. Medina, Lake 245.
327	Perkinsville.	"	4	Wallington.	" "
	Wayland.	1359	6	Sodus Centre.	5 b. Clinton.
332	Dansville.	1038	10	Zurich.	" "
332	Groveland.	598	13	Fairville.	5 c. Niagara.
346	Mt. Morris.	574	16	Newark.	6. Salina. 418
349	Leicester.	650	20	Marbleton.	" "
358	York.	929	22	Outlet.	" "
363	Roch. & Pitts. Ju.	"	23	Phelps.	9 c. Corniferous.
367	East Bethany.	958	27	Orleans.	" "
374	Alexander.	890	31	Flint.	" "
			34	Stanley.	10 b. Hamilton. 904

72. Midway between Watertown and Brownville the whole river falls 60 feet in less than half a mile, running in a gorge with high banks.

73. *Tully*. The Tully limestone, separating the Hamilton from the Genesee, which is named from this place, is not seen on the railroad, but is found further to the west. Outcrop in grove S. E. of the village. The swamp near Preble is supposed to be underlain by the Tully limestone.

74. Between Syracuse and Jamesville are good natural sections of the 6. Waterlime and 9. Onondaga and Corniferous limestones, many quarries and natural cliffs. Beyond Jamesville observe the transition into the Hamilton group where the high hills begin, the Marcellus shales being deeply excavated. Visit Green Lake, near Jamesville.

75. The red sandstone of the 5 a. Medina formation is well displayed at Fulton, in Oswego County, where it causes the Oswego Falls and forms the banks and bed of the river above and for half a mile below. The upper layers are covered with *Fucoides Harlani*, some of them of gigantic size.

76. The 5 b. Clinton formation is named from this place.

77. This is one of the best railroads in the State for geological observations. There are many points on the Cayuga Railroad where the junction of the Hamilton with the Tully limestone and of the latter rock with the Genesee shale, and of the Genesee with the Portage group are perfectly seen in juxtaposition. The lake affords every evidence and facility for geological sections, with fossils.

78. Cayuga Lake is 40 miles long, $3\frac{1}{2}$ miles wide, 390 ft. deep, and its surface is 376 ft. above tide.

79. The gypsum beds are finely displayed just north of Union Springs, and large quantities are produced for market. South of the town the 9. Upper Helderberg range crosses, and causes an islet in the lake. Its lower layers, the Onondaga limestone, make beautiful quarries.

80. The low clayey land extending nearly to Levanna is on the 10 a. Marcellus shale. The first rock south of this is the dividing line between the Marcellus and Hamilton.

81. The 10 b. Hamilton presents its first bluff south of Aurora, 20 to 50 feet high, containing numerous fossils. Further south are many others, some of them 100 feet high, extending for miles. Nothing could be finer than these geological sections of the Hamilton.

82. The Tully limestone first appears at Lake Ridge, from which the station is named. It is the dividing line between the 10 b. Hamilton and the 10 c. Genesee. It dips as you go south and rises again. This looks like a flexure of the formations, but it is caused by the change in the course of

Lehigh Valley Railroad.			Pa. & N. Y. Canal & R. R.—Con.		
Ms.	Cayuga Branch. 77	Alt.	Ms.		Alt.
0 Cayuga. ⁷⁸	888	6 Salina. Lake, 876.	0 Freeville.	11 a. Portage.	1048
6 Union Springs. ⁷⁹	894	{ 6. Salina, with Gyp- sum beds. 9 c. Corniferous quarries. 10 a. Marcellus. 10 b. Hamilton.	4 West Dryden.	"	
10 Levanna. ⁸⁰			7 Asbury Road.	"	
18 Aurora. ⁸¹			10 South Lansing.	"	
16 Willett's.		925	14 North Lansing.	"	
20 King's Ferry.	894	" Bluffs 100 ft.	17 Genoa.	"	
22 Atwater's.		894	28 Venice Centre.	"	
25 Lake Ridge. ⁸²	401	" Tully limes.	27 Scipio. ¹⁹⁷	"	799
27 Taughannock.	411	" "	Geneva, Ithaca & Sayre R. R.		
32 Ludlowville. ⁸³		{ 10 c. Genesee and Portage.	0 Sayre. ¹⁰⁹	11 b. Chemung.	774
88 Ithaca. ⁸⁴	896		2 West Waverly.	"	808
Pa. & N. Y. Canal & R. R.			9 Bingham's	"	
0 Sayre. ¹⁰⁹	11 b. Chemung.	774	16 Van Ettenville.	1010	"
7 Barton.	"	808	19 Spencer. ¹⁸⁸	1006	"
10 Smithboro.	"	799	28 North Spencer.	"	
14 Tioga.	"	805	27 West Danby.	872	"
20 Owego. ¹⁸⁸	"	822	81 Newfield. ¹⁹¹	"	
24 Flemingville.	"	907	38 Ithaca. ⁸⁴	11 a. Portage.	
29 Newark Valley.	"	966	44 Willow Creek.	"	
35 Berkshire.	"	1048	46 Taghanic Falls.	"	Gulf.
39 Richford.	"	1097	48 Trumansburg.	"	878
43 Hartford Mills.	"		51 Covert. ⁸⁵⁸	" Tully limes.	
45 Hartford. ¹⁹⁸	"	1186	54 Farmer.	10 b. Hamilton.	860
51 Dryden. ¹⁹⁶	" Sum'it, 1215		57 Ovid Centre.	"	819
54 Freeville.	11 a. Portage.	1049	61 Hayt's Corners.	"	896
56 Peruville.	"		65 Romulus.	"	719
59 Groton. ¹⁹⁶	"	997	70 West Fayette.	"	809
65 Locke. ¹⁹⁷	799	" on 10 c. Gen.	77 Geneva. ⁸¹	459	{ 9 c. Corniferous. An ancient deep chan- nel northward, fill'd with gravel dr't. ⁴⁵³
69 Moravia. ⁹⁸	"	782	Syracuse, Geneva and Corning R. R.		
78 Cascade. ⁹⁹	10 b. Hamilton.	724	0 Geneva. ⁸¹	9 c. Corniferous. ⁴⁵⁹	
76 Scipio. ¹⁹⁷	730	" (Glen.)	9 Earle. ⁸⁹	10 a. Marcellus.	
70 Wyckoff's. ⁹⁹	"	726	14 Dresden. ⁸⁷	{ 815 " Tully lime- stone, 1 mile south.	
(Foot of Lake.)			21 Himrod's.	10. Hamilton.	799
86 Auburn. ⁸⁰	9 c. Corniferous.	666	26 Dundee.	"	890
90 Throop.	6. Salina, 13 miles.	429	30 Rock Stream.	11 a. Portage.	
95 Weedsport. ⁸³	"		33 Reading Centre.	"	1048
99 Brick Church.	"		36 Watkins Glen.	"	1020
104 Cato.	"	428	37 Glen Bridge. ⁸⁶	{ 1021 " View of Glen. Bridge 150 ft. high.	
108 Ira.	5 c. Niagara.		45 Beaver Dam.	11 a. Portage.	1279
112 Martville.	5 c. Clinton.	867	49 Post Creek.	11 b. Chemung.	1187
115 Sterling.	"		52 Ferrenburg.	"	
116 Fair Haven.	5 a. Medina, 3 miles.		58 Corning. ¹⁸⁸	"	943
118 N. Fair Haven. ⁷¹	" Lake, 245.				

the lake. After rising again it forms a beautiful coping of the Hamilton group for miles above Taughannock. See the description of the 10 b. Tully limestone.

83. This is one of the best localities of the Hamilton group which we know. South of Ludlowville the 10 c. Genesee shale appears above the Tully limestone. It is uniformly black, of a slaty structure, fine grained, a hard and brittle mud rock, its edges resisting the weather, but its surface when exposed falling into pieces. You get a good section of the base of the Portage here. There is a well marked dividing line here between the Genesee and Portage, being a sandstone 2 or 3 feet thick, very compact and solid, with its under surface filled with fucoids raised in relief, one or two inches long with their ends depressed. The eye readily follows it as it dips toward the water.

84. Every part of the Portage group can be inspected in the ravines and water falls in the vicinity of Ithaca.

85. There is a glen here, one mile southeast from the station, quite equal to that at Watkins. It is also in the Portage. See Note 86.

86. Watkins Glen is in the 11 a. Portage. It is a great wonder and very beautiful. There is a grand view of the chasm in crossing the bridge over it at Glen Bridge on the Syracuse, Geneva & Corning. The gulfs on that road are perfectly characteristic of the Portage group.

Elmira, Cortland & Northern, formerly				Ms. New York, Ontario & Western R. R. Alt.			
Ms.	Utica, Ithaca and Elmira Railroad.	Alt.		New York, (Erie Railroad), N. W.			
0	Elmira.	11 b. Chemung.	862	0	Middletown.	4 c. Hudson River.	550
5	Horse Heads.	"	899	5	Fair Oaks.	"	
10	Breesport.	"	1097	10	Bloomingsb'g.	5 a. Oneida.	757
14	Erin.	"		101	Tunnel,	3,840 feet.	
17	Park.	"		12	Wurtzboro.		
21	Swartwood.	"		15	Summitville.	10. Hamilton, 11 a.	543
25	Van Etten.	"		30	Fallsburg.	Portage & Chemung.	
28	Spencer.	"		39	Liberty Falls.	12. Catskill. Tunnel.	
32	West Candor.	"		40	Liberty.	Striae.	1,017 ft.
34	North Candor.	"		46	Parksville.	"	1798
37	Wilseyville.	"		51	Morseton.	11. Chemung.	
42	White Church.	"		63	Cook's Falls.	"	
44	Mott's Corners.	11 a. Portage.	945	73	East Branch.	"	
46	Besemer's.	"	949	82	Hancock.	12. Cat'l. Tun'l, 1,100 ft	954
50	Ithaca.	Striae.	840	89	Codosia Summit.	"	1463
53	Varna.	"		93	Rock Rift.	"	1152
54	Snyder's.	"	995	101	Walton.	Junc'n of the 11.	1220
57	Etna.	"	1010	108	Zig Zag.	Chem. & 12. Catsk.	1683
60	Freeville.	"	1049	117	Sidney Centre.	12. Catskill, synclinal.	
62	Malloryville.	"	1059	125	Sidney Plains.	11 b. Chemung.	967
63	McLean.	"	1090	127	New Berlin Jun.	"	
67	Sou. Cortland.	"	1151	134	Guilford.	"	1399
70	Cortland.	"	1116	143	Oxford.	"	
71	D. L. & W. Dep't.	"	1116	148	Norwich.	11 a. Portage.	763
0	Cortland.	11 a. Portage.	1116	163	Earlville.	10 c. Genesee.	
12	Truxton.	" V'y drift.	1135	167	Smith's Valley.	10 b. Hamilton.	
16	Cuyler.	"	1225	172	Eaton.	10 a. Marcellus.	
20	De Ruyter.	10 c. Genesee.	1276	174	Morrisville.	9 c. Cornifer. l. s. in	
0	De Ruyter.	10 c. Genesee.	1276	181	Munnsville.	" hills.	
10	Otselic.	11 a. Portage.		183	Cook's Corners.	6. Salina.	
20	Plymouth.	11 b. Chemung.		187	Oneida Comm'ty.	5 c. Niagara.	
28	Norwich.	"	1001	190	Oneida.	5 b. Clinton.	412
Elmira, Cortland & Northern R. R. 26				192	Durhamville.	"	
0	Canastota.	6. Salina.	426	200	North Bay.	"	
3	Clockville.	"	637	209	Cleveland.	" Lake, 367	Deep drift
4	Colton.	"		216	Constantia.	"	glass sand.
5	Oak Hill.	" Gypsum in cuts.		223	Central Square.	"	
6	Quarries.	9. Onondaga limest'ne.		230	Pennellville.	"	
8	Perryville.	"	1041	238	Fulton.	5 a. Medina.	355
9	Hyatt's.	"		250	Oswego.	" Lake, 245.	
11	Chitt'go Falls.	10 c. Marcellus.	1031	101	Walton.	(As before.)	
12	Bingley.	"	1041	105	Colchester.	12. Catskill.	
13	Shelter Valley.	"		109	Hawley's.	"	
14	Firndell.	10 a. Hamilton.		112	De Lancey's.	"	
15	Cazenovia.	"	1176	118	Delhi.	"	
17	Syr. & Chen. Ju.	"	1248	127	New Berlin Jun.	11 b. Chemung.	
22	New Woodstock.	"	1293	134	Mount Upton.	"	
26	Shedd's Corners.	"	1383	140	Holmesville.	"	
30	De Ruyter.	10 c. Genesee.	1276	145	New Berlin Cen.	10. Hamilton.	
				149	New Berlin.	"	

87. The outlet of Crooked Lake from Penn Yan to Dresden is through the Genesee slate, Tully limestone, and the upper part of the Hamilton—all finely displayed. Crooked Lake is 20 miles long, one mile wide, 100 feet deep, and its surface is 718 feet above tide water. Its northern half is divided by a bluff of Portage (800 feet high) into two branches—one of them 12 and the other 8 miles long.

88. Canandaigua Lake is 14 miles long, from one to two miles wide, its surface is 668 feet above tide, and its greatest depth is 100 feet, but it is very shallow at both ends. It is excavated from the Hamilton and Portage groups.

89. The drift described in note 31 extends nearly to Dresden.

90. The D., L. & W. From Binghampton to Buffalo is by Prof. H. S. Williams of Cornell University. Compare formations and notes on N. Y., L. E. & W.

Ms. New York, Ontario & Western.—Con. Alt. Ms. New York, Lake Erie & West'n.—Con. Alt.

0 Middletown.	4 c. Hudson River.	47 Turner's. ¹²⁸	87 Low. Silur'n l. s. ⁵⁴⁴
15 Summitville.	"	49 Monroe. ¹²⁹	4 c. Hudson River.
17 Phillipsport.	"	50 Schunemunk Mt.	107 Middle Devonian.
19 Homowack.	"	51 Oxford.	87 Low. Silur'n l. s. ⁵⁴⁰
23 Ellenville.	" and Trenton.	53 Greycourt. ¹³⁰	4 c. Hudson River.
Cornwall to Middletown. ¹²³		59 Goshen.	" 481
0 Cornwall. ^{116, 142}	4 c. Hudson River.	66 Middletown.	" 563
8 Montana.	"	70 Howell's.	" 699
6 Meadow Brk. ¹²⁴	Red Grits and Cong.	75 Otisville. ¹⁰⁸	" 870
7 Dennistons. ¹⁴²	4 c. Hudson River.	Kittatiny, Blue, 5 a. Oneida, or Shaw- or Shawangunk angunk and Medina.	
12 Rock Tavern.	"	Mountain.	
14 Burnside.	"	87 Port Jervis. ¹⁰¹	
16 Campbell Hall.	"	128 { 7. Low'r Helderberg. 8. Oriskany. 443 9. Canda Galli & Up. Heldg. & 10. Hamilt.	
18 Stony Fork.	"	Sparrowbush.	
21 Ireland.	"	11 a. Portage.	
23 Mechanicstown.	"	99 Pond Eddy, Pa.	
25 Middletown.	"	106 Shohola.	
New York, Lake Erie and Western R. R. (Late Erie Railway.)		110 Lackawaxen. ¹⁰⁷	
New York.		116 Pine Grove.	
0 Jersey City. ¹⁰³		122 Narrowsburg. ¹⁰⁷	
(Tide Marshes). ¹⁰⁴		131 Cochection, N. Y.	
9 Rutherford P'rk.		135 Callicoon.	
11 Passaic. ¹²⁷		136	
16 Paterson.		143 Hawkins.	
21 Ridgewood		147 Basket.	
23 Hohokus.		154 Lordville.	
25 Allendale.		159 Stockport.	
27 Ramsey's.		163 Hancock.	
31 Suffern, N. J. ¹⁰⁵		172 Hale's Eddy.	
33 Ramapo, N. Y.		176 Deposit.	
34 Sterling Junc.		184 Summit. ¹⁰⁹	
35 Sloatsburg.		192 Susquehan'a. ¹⁰⁸	
41 Southfield.		200 Great Bend. ²⁰⁰	
43 Greenwood. ¹⁰⁵		12. Catskill ridge. 743	
		11 b. Chemung.	
		12. Catskill,(bluffs). 781	
		11 b. Chemung.	
		12. Catskill. 926	
		11 b. Chemung. 980	
		1008	
		1878 "Mt. to N. Cats	
		914	
		884	

91. Just south of the Erie Canal there is a deep cut in a bluff of Waterlime Group.

92. Picturesque view of Pompey Valley.

93. Cazenovia Lake is a beautiful lake, $4\frac{1}{2}$ miles long, $\frac{3}{4}$ mile wide, and 70 feet deep, 1,189 feet above tide water, and is excavated in the Hamilton group. It discharges its waters into Chittenango Creek, which runs northward.

94. Lebanon and Earlville are both good localities for Hamilton fossils.

95. Extensive and beautiful view extending over Oneida Lake.

96. Canaseraga Falls similar to Chittenango Falls. Note 97.

97. The Falls are in sight in the valley to the west. Here Chittenango Creek falls 120 feet perpendicularly into a canon over the 9. Onondaga limestone, with the Corniferous bed over it, which forms the sides of the creek at the top of or above the Falls. Under the Onondaga limestone is the Oriskany sandstone, only six inches thick. Above the Falls the creek flows through a small, handsome valley, its lower sides formed of Marcellus, and the tops of the hills Hamilton.

98. Moravia is an excellent locality for Hamilton fossils. The Tully limestone, the dividing line between the Hamilton and Genesee, is half way up the hill sides, and appears to dip below the valley north of Locke. It is met with at the falls of Dry Creek, south of Moravia.

99. Owasco Lake is 10 miles long, a mile and a half wide at the north at Auburn, and a half mile at the south end, and 750 feet above tide water. The whole of the lake is in the Hamilton group.

100. Marl is here taken from the bottom of ponds; dried like bricks, and burnt into lime.

101. From Bloomingburg tunnel to Sidney, the geology is the same as from Port Jervis to Susquehanna on the Erie Railway. In the hills at Port Jervis, fossils of L. H., Oriskany and Hamilton.

102. Oneida Lake is 19 miles long, 6 miles wide, its greatest depth not over 40 feet, and in general it is quite shoal. Its surface is 367 feet above tide water. It is excavated in the 5 b. Clinton group the rocks of which appear on its south shore and west end. Its north shore is covered with sandy alluvium which is 100 feet deep at the east end and furnishes glass sand used in the glass factories in this vicinity.

103. The Erie railway tunnel at Jersey City is through Bergen Hill, which is the southern end of the mountain ridge of basalt or trap rock of the 16. Triassic age, 48 miles long, known farther north as the Palisade Mountain. See note 5.

104. The railroads out of New York through New Jersey pass over very extensive tide marshes, covered with reeds and coarse sedge grass, growing in soft mud, which is in some places forty feet deep, and all overflowed in high tide. These vast salt marshes so near New York City, which excite

Ms. N. Y., Lake Erie & Western.—Con. Alt.			Ms. N. Y., Lake Erie & Western.—Con. Alt.		
295 Kirkwood.	11 b. Chemung.	878	331 Hornellsville.	11 b. Chemung.	1161
214 Binghamton. ¹⁰⁸	"	868	340 Alfred. ²⁰¹	Fossils.	1660
223 Union.	"	840	349 Andover.	"	1640
229 Campville.	"	830	357 Genesee.	"	1526
236 Owego. ¹⁸⁸	"	822	365 Phillipsville.	"	1390
246 Smithboro.	"	799	369 Belvidere.	"	1384
248 Barton.	"	803	373 Friendship.	"	1539
255 Waverly. ¹⁰⁹	"	836	382 Cuba.	1542	"Sum't, 1698.
260 Chemung.	"	817	389 Hindsdale.	"	1501
266 Wellsburg.	"	831	394 Olean. ²⁰¹	"	1438
273 Elmira. ¹⁰⁸	"	863	398 Allegany.	"	1422
290 Corning. ¹⁸⁸	"	942	407 Carrollton.	"	1399
301 Addison.	"	993	410 Great Valley.	"	1393
331 Hornellsville.	"	1161	413 Salamanca.	"	1384
343 Canaseraga.	Mor.?	"	421 Little Valley.	"	Mor. 1594
355 Nunda. ¹⁹¹	11 a. Portage.	1336	428 Cattaraugus. ²⁰⁸	"	1411
361 Portage. ^{110, 191}	"	1314	437 Dayton.	"	Mor. 1346
365 Castile. ¹⁹¹	"	1401	440 Perrysburg.	"	1260
374 Warsaw.	"	1326	447 Smith's Mills.	"	1610
380 Dale.	"	1190	451 Forestville.	"	883
391 Attica.	"	998	454 Sheridan.	11 a. Portage.	760
395 Griswold's.	10 b. Hamilton.	1044	459 Dunkirk.	"	598
397 Darien. ¹⁶⁰	"	1024	76 Avon. ¹¹¹	585	9 c. Cor. & 6. Water Li.
403 Alden.	10 a. Marcellus.	864	83 Caledonia.	688	"
408 Town Line.	9 c. Corniferous.	742	90 Le Roy.	872	"
412 Lancaster.	"	683	94 Stafford.	910	"
420 East Buffalo.	"	607	100 Batavia. ⁴¹	895	"
422 Buffalo. ^{40, 197}	588 " Lake. 569.		107 Alexander.		10 b. Hamilton. 938
0 Corning.	11 b. Chemung.	942	110 Attica.		11 a. Portage. 938
1 Painted Post.	"	945	76 Avon. ¹¹¹		9 c. Corniferous. 585
5 Coopers'.	"	970	80 South Avon.		" and Marcell.
7 Curtis'.	"	997	85 Genesee.		10 b. Hamilton. 600
9 Campbell's.	"	1014	89 Cuylerville.		" 528
14 Savonia.	"	1053	90 Shaker's.	574	11 a. Chasagua shale.
20 Bath. ²⁰⁵	Mor.?	1105	91 Mt. Morris. ¹¹²		10 c. Genesee. 595
23 Kanona.	"		94 Sonyea.		" 592
27 Avoca.	"	1198	98 McNair.		" 576
30 Wallace's.	"	1235	102 West Sparta.		11 a. Portage.
35 Liberty.	Mor.?	1293	106 Dansville. ¹¹³		" 691
39 Blood's.	"	1325	New York, Pennsylvania and Ohio R. R. 136		
45 Wayland.	"	1389	0 Salamanca.	11 b. Chemung.	1393
50 Springwater. ¹⁹¹	11 a. Portage.	1370	12 Steamburg.	"	1318
53 Webster. ¹⁹¹	"	1348	18 Randolph.	"	1264
57 Conesus.	"	1280	25 Kennedy.	"	1331
60 South Livonia.	11 b. Hamilton.	1167	34 Jamestown. ¹¹⁵	"	
64 Livonia.	"	1030	39 Lakewood. ¹¹⁵	"	
67 Hamilton.	"	920	41 Ashville.	"	1356
76 Avon. ¹¹¹	585 9 c. Cornif. and Water.		51 Bear Lake, Pa.	"	1550
80 Rush.	541 6. Salina. lime.		58 Columbus.	"	1427
82 Scottsville.	"	558	61 Corry, Pa.	1428	" Carbonif.
86 Henrietta.	"	564			
90 Red Creek.	"	525			
94 Rochester. ³²	527 5 c. Niagara, 3 miles.				

the wonder of strangers, contain from 250,000 to 300,000 acres or from 400 to 470 square miles. Future generations may build dikes and reclaim them, but at present they are dismal swamps without a single tree or shrub, and wholly impassable to either man or beast. The two hills which rise abruptly in the salt meadow south of the Erie Railway and north of the Pennsylvania Railroad, are called Big Snake Hill and Little Snake Hill. The large one is half a mile long and 200 feet high. Both of these hills are outbursts of trap from between the underlying sandstone strata, similar to the Fallsade Mountain.

106. *Chuffern to Greenwood.* Here is a long natural gap through the Laurentian Highland range or Ramapo Mountains.

New York, Lake Erie & Western.—Con.			New York, Lake Erie & Western.—Con.		
Ms. Suspension Bridge & Niagara Falls Branch. Alt.			Ms. Walkill Valley Railroad. Alt.		
420 Buffalo.	9 c. Corniferous	588	0 Jersey City.	(See Main Line Erie R.)	
420 East Buffalo.	"	607	59 Goshen. ¹⁰⁵	4 c. Hudson Riv.	481
426 Main Street.	"	630	61 Ripp's.	"	391
431 Tonawanda.	6. Salina.	580	64 Campbell Hall.	"	391
437 La Salle.	"	572	66 Neely Town.	3 a. L. Sil. l. s. (fos.)	388
442 Niagara Falls. ³⁹	5 c. Niagara.	574	68 Beaver Dam.	"	406
443 Susp. Bridge. ⁴²	"	580	69 Montgomery.	"	396
444 Clifton, Ont.	"		78 Walden.	351 " Fossils	
Lockport Branch. ¹⁸⁶			76 Shawangunk.	{ 5 a. On'da or Shawk Grit and Medi. ³⁷⁷	
0 Buffalo.	9 c. Corniferous.	588	79 New Hurley.	{ 7. Lower Helderberg and 9. Upper Held'g, mainly Upper.	
8 Tonawanda.	6. Salina.		82 Gardner.	"	311
18 Hodgeville.	"		85 Forest Glen.	"	386
22 Lockport. ³⁸	5 c. Niagara.		87 New Plats.	"	
Piermont Branch.			91 Springtown.	"	
0 Suffern. ¹³¹	16. Triassic.	298	94 Rosendale. ¹¹⁴	4 c. Hudson River. ¹⁰⁷	
9 Nanuet.	"	284	96 Katson's Cave.	"	
17 Piermont. ¹²²	" Trap.	6	98 Whiteport.	"	129
Northern Railroad of New Jersey.			102 Kingston. ¹¹⁴	186 " & Waterli	
0 Jersey City. ¹⁸³	16. Triassic.	Trap.	Monticello and Port Jervis Railroad.		
4 Homestead. ¹³³	"		0 Port Jervis. ¹⁰¹	10. Hamilton.	443
6 New Durham. ¹⁸⁴	"		6 Huguenot. ²⁰⁶	"	
7 Granton. ¹³⁵	"	Trap.	8 Rose Point.	11 b. Chemung.	
9 Ridgefield.	"		12 Paradise.	"	
12 Leonia.	"		13 Oakland.	"	
14 Englewood.	"		16 Hartwood.	"	
15 Highland.	"		18 Gillman's.	"	
16 Tenafly.	"		20 Barnum's.	"	
17 Cresskill.	"		24 Monticello. ²⁰⁷	12. Catskill.	
19 Closter.	"				
21 Norwood.	"				
23 Tappan.	"				
24 Sparkill. ¹²²	" 20 Quat.				
25 Piermont.	" Trap.				
29 Nyack.	"				

106. *Otisville.* A short distance west of Otisville the Hudson River Slates are seen in contact with the Shawangunk Grits along a fault line. This is the dividing line between two of the great geological groups or periods, the Lower Silurian and Upper Silurian. In a moment the whole character of the country is changed from cultivated grazing land on the Hudson River slates, the Orange County milk country to the east of this line, to a poor, barren, rocky region on the Oneida or Shawangunk and Medina formations, showing in a striking manner how the character of the country depends on its geology. In descending the Shawangunk Mountain towards Port Jervis there is an alternation of beds of the Oneida conglomerate, which is of a light gray color, and the Medina sandstone, which is of a high red color. Some pockets of galena were discovered and mined here, but were soon exhausted. At Port Jervis we are in the Hamilton, a formation producing a country capable of supporting a population. The intermediate formations are very thin and compressed together.

107. *Lackawanna.* From Port Jervis to Narrowsburg, the Delaware River and Erie Railway pass through a deep and crooked gorge about 25 miles long, exhibiting some of the wildest scenery in the country. The railroad is cut out of rock in many places and overhung as it were by ragged precipices.

108. *Binghamton.* West of Susquehanna the Erie Railway and its branches run for more than 300 miles on the 11 b. Chemung formation. Most of it is a fine fertile country with some handsome towns, the largest of which are Elmira and Binghamton, in valleys filled with gravel alluvium, and the higher country formed of the calcareous Chemung shales, is quite productive, much of it being a good grazing country; but there is no variety in its geology. East of Susquehanna the Chemung formation is composed of harder sandstone. It contains less calcareous shale, and the soil is poor. The country improves rapidly going westward from Susquehanna. See also 185.

109. Just west of Waverly are the Chemung Narrows, where 100 feet of rock are exposed. The quarries have produced an abundance of characteristic fossils of the Chemung group in their greatest beauty and perfection, the formation having been named from this locality. Five miles south of Waverly the opening of the Susquehanna Valley may be seen, where the Chemung River from the west and the Susquehanna from the east unite and traverse the State of Pennsylvania to Chesapeake Bay. At the west end of Waverly Village is a curious flat-topped hill, about 60 feet high, called "Spanish Hill." It is an eddy hill of gravel formed in the drift period; but it can be seen to better advantage on the south side, at Sayre on the Pa. & N. Y. R. R. and the G. I. & S. R. R. There is a similar eddy hill in the village of Union. The plain at Sayre is "Valley Drift."

110. *Portage.* Here the railroad crosses the very deep gorge of the Genesee River on a high iron bridge 820 feet long and 235 feet high. There are three falls within a distance of two miles which

New York, Lake Erie & Western.—Con.			New York, Lake Erie & Western.—Con.		
Ms.	Buffalo, Bradford & Pittsburgh R. R.	Alt.	Ms.	Newburg Branch. ¹²⁸	Alt.
0	Carrolton.	1399	0	Greycourt. ¹³⁰	4 c. Hudson River.
6	Limestone.	1416	2	Craigville. ¹⁴²	"
11	Bradford's, Pa.	1464	7	Washingtonville.	"
Buffalo and Southwestern.			9	Salisbury.	"
0	Buffalo. ⁴⁰	9 c. Corniferous. 888	13	Vails Gate.	" 280
3	Junction.	"	16	New Windsor.	" 192
5	Limestone Ridge.	"	20	Newburg. ¹⁸⁸	" 25
10	Abbott Road.	"	Pine Island Branch. ¹²⁸		
13	Hamburg.	10. Hamilton. 635	0	Goshen. ¹⁴²	4 c. Hudson River. ⁴²¹
16	Eden Valley.	11 a. Portage.	3	Orange Farm.	3? Lower Silurian.
19	Eden Center.	"	6	Florida.	"
23	North Collins.	" 846	12	Pine Island.	"
27	Lawton's.	11 b. Chemung.	Syracuse, Ontario & New York Railroad.		
30	Collins.	"	0	Syracuse. ²⁷	6. Salina. 403
33	Gowanda.	" 776	8	Manlius Cen. ⁹¹	7. L. Held., Waterli. ⁴²⁵
39	Dayton.	" Moraine 885	10	Fayetteville.	{ 9. Onondaga limest. & 9. Onon. l. s. 538
43	Pine Valley.	"	12	Manlius.	{ Heavy beds. 742
48	Cherry Creek.	"	15	Oran. ⁹²	9. Onondaga l. s. 897
53	Clear Creek.	"	Tunnel. 1218		
56	Randolph.	" Moraine.	{ 10 a. Marcellus.		
60	Kennedy.	"	{ 10b. Tunnel in Ham-		
69	Jamestown. ¹¹⁵	" Moraine.	{ ilton sandstone.		
Tioga, Elmira & State Line Railroad.			20	Cazenovia. ⁹³	10. Hamilton. 1191
0	Elmira. ¹⁰⁸	11 b. Chemung. 888	23	Webster's.	"
1	Erie Junction.	"	29	Erieville.	" 1877
3	State Line Junc.	" 909	32	Georgetown.	" 1450
7	Wells.	" 995	38	Lebanon. ⁹⁴	{ 10 c. Genesee. 1826
9	Seeley Creek.	" 1041	{ 11 a. Portage, cliffs.		
10	State Line.	"	45	Earlville. ¹⁸⁸	10 c. Genesee. 1071
12	Millerton, Pa.	" 1246	New Jersey and New York R. R. ¹²⁸		
15	Trowbridge.	12. Catskill. 1440	0	Spring Valley.	16. Triassic.
Middletown & Crawford Branch.			Pomona.		
0	Middletown.	4 c. Hudson River. 562	Mt. Joy. ¹³⁹		
3	Crawford Junc.	"	Thials.		
5	Circlesville.	"	9 Haverstraw.		
8	Bellville.	"	11 Stony Point.		
10	Thompson Ridge.	"	Dunkirk, Allegheny Val'y & Pitts. R. R. ¹⁸⁶		
13	Pine Rush.	"	0	Dunkirk.	11 a. Por. & 11b. Che. 598
Newburg Branch. ¹²⁸ (Short Cut.)			3	Fredonia.	11 a. Portage. 765
0	Greenwood.	1 Archæan. 820	5	Laona.	" 810
2	Junction. ¹²⁸	3? Lower Silurian, l. s.	13	Lily Dale.	"
Central Valley.			14	Cassadaga.	11 b. Chemung. 1309
5	High'd Mills. ¹²⁶	Silurian Grits. 480	18	Moons.	" 1803
7	Woodbury,	{ 10? Green Pond Mt.	22	Sinclairville.	" 1830
{ S'rs, Mid. Dev'n. 442			26	Gerry.	"
Mountainville.			29	Ross' Mill.	" 1242
18	Cornwall. ¹²⁶	3? Lower Silurian, l. s.	32	Falconer.	" 1258
15	Vails Gate Junc.	4 c. Hud. Riv. 280, 142	33	Junction.	" 1262
17	New Windsor.	" 192	38	Frewsburg.	" 1261
20	Newburg. ¹⁸⁸	" 25	Con. in Pa.		

are 60, 90 and 110 feet high, besides the intervening rapids. Two of them are visible from the car windows on the north side. The bridge crosses the upper falls. The river pursues a meandering course through this deep gorge and over these three successive cascades, descending more than 500 feet, and passes out into the Valley of the Genesee at Mount Morris. The gorge is 20 miles long by the river, or 14 by the public road, and its depth in some places is not less than 350 feet, its width only about 600 feet, and the banks nearly perpendicular. The place is well worth a visit. It is cut out of the 11 a. Portage group, except the lower end, which is in the 10 c. Genesee shale. The Portage group was named from this place. See note 112, Mount Morris. There is an ancient channel from Portage to Nunda, filled up by drift, compelling the river to cut its present deep, tortuous channel. For other examples of this see notes 31, 35, 38 and 39.

111. *Avon.* You have 9. Upper Helderberg, and 10 a. Marcellus shale in the creek.

112. To study the Genesee shales stop at Mount Morris. Go through the village one way

Ms. Lake Shore & Mich. Southern R. R. Alt.			Ms. Buffalo, Rochester & Pittsb'g R. R. Alt.		
0 Buffalo. ⁴⁰	9 c. Corniferous	558	0 Rochester.	5 c. Niagara.	488
10 Hamburg. ¹⁴⁸	10 Hamilton.	535	5 Maplewood.	"	
21 Angola.	"	587	7 Brookdale.	6. Salina.	
26 Farnham.	"	523	11 Scoffsville.	"	558
29 Irving.	"	586	14 Garbuttville.	6. Waterlime.	
31 Silver Creek.	10 c. Genesee.	533	15 Wheatland.	"	590
40 Dunkirk. ⁵⁹⁸	11 a. Port. & Chemung.		17 Mumford.	"	618
49 Brocton Junc'n.	689 " "		21 Lime Rock.	9 c. U. Helderberg.	770
57 Westfield.	697 " "		25 Le Roy.	"	572
65 Ripley, Pa.	" "		30 Pavilion Center.	10. Hamilton.	940
73 North East.	805 " "		33 Pavilion.	"	940
80 Harbor Creek.	781 " "		38 Wyoming.	10 c. Genesee.	965
84 Wesleyville.	" "		43 Warsaw.	11 a. Portage.	1120
88 Erie.	686 " "		48 Rock Glen.	"	
98 Fairview.	" "		54 Gainesville.	" Mor.	1407
103 Girard, Pa.	717 " "		62 Bliss Corners.	"	
115 Conneaut, Ohio.	11. Erie Shale.		65 Eagle Village.	Moraine. " Sum't. 1909	
123 Kingsville.	672 " "		83 Machias.	1646 " & 11 b. Che.	
128 Ashtabula. ¹⁴⁸	648 " "		93 Ashford.	Mor. " "	
(Continued in Ohio.)			97 Ellicottsville.	Moraine. " "	1560
			102 Great Valley. ²¹⁰	" "	1398
			108 Salamanca.	Valley drift. " "	1397
New York, Chicago & St. Louis Ry.			Buffalo Division. ¹³⁶		
0 Buffalo.	9 c. Corniferous.		0 Buffalo.	9 c. Corniferous.	
2 Erie Junction.	"		2 Buffalo Creek.	10. Hamilton.	
9 Bay View.	10. Hamilton.		5 W. Seneca.	"	
15 Lake View.	"		10 Hamburg.	"	
28 Irving.	"		11 Orchard Park.	"	
32 Silver Creek.	10 c. Genesee.		16 West Falls.	"	
42 Dunkirk.	11 a. Port. 11 b. Chem.		21 Colden.	11 a. Portage.	
50 Brocton Ju.	" "		23 Glenwood.	"	
58 Westfield.	" "		28 E. Concord.	"	
66 Ripley, Pa.	" "		31 Springville.	"	
88 Erie.	" "		38 Riceville.	"	
103 Girard.	" "		41 W. Valley.	"	
116 Conneaut, Ohio.	11. Erie Shale.		48 Ashford.	11 a. Por. 11 b. Chem.	
Bath and Hammondsport R. R.			57 Gt. Valley Cent.	11 b. Chemung.	
0 Bath. ²⁰⁵	11 b. Chemung.	1105	62 Bradford Ju.	"	
5 Cold Spring.	"		63 Kilbuck.	"	
9 Ham'dsport. ¹⁹⁷	"		66 Carrolton.	"	
			72 Limestone.	"	

northwest to the mouth of the gorge, where the Genesee River, after running 20 miles through the deep canon from Portage, breaks out into the beautiful broad and fertile Genesee Valley. There is a good section close to the bridge over the river. Get a boat and row one mile up the pool of the State dam, which flows to the foot of the precipices all that distance. This is the finest exposure of the 10 c. Genesee in the State, the typical locality from which it was named, and the scenery is in itself remarkably good. The cliffs are 100 to 200 feet perpendicular, full of *Spirifer*, like flattened cannon balls sticking in the walls. It is curious that so soft a shale rock should stand the weather so well and not form sloping banks when the edges only are exposed. See Note No. 110, Portage.

113. Dansville is in a beautiful amphitheatre of Portage hills with very picturesque views from the Water Cure and other elevated points. Moraine Kame-like hills of glacial origin.

114. The Rosendale Cement, manufactured near Rondout, is from the 6. Waterlime rock, which is here between the Medina sandstone and the Lower Helderberg limestone, the intermediate formations being wanting. It is a light blue, fine grained limestone, with smooth conchoidal fracture. The same formation furnishes the Hydraulic Cement, made at Syracuse, N. Y., and elsewhere.

115. *Jamestown*. Chautauqua Lake is 18 miles long, 2 miles wide, 1291 feet above tide water and 726 above Lake Erie. Its northern extremity is only 8 miles from Lake Erie, and yet it empties its waters by the Conewango, Alleghany, Ohio and Mississippi into the Atlantic. It is a beautiful sheet of water, bounded on its eastern side by gravelly sloping banks, and on the west by more level and in some places marshy shores. It is excavated in the Chemung group, the Portage being along its outlet and on the shores of Lake Erie below, but of much less thickness than further east.

116. *Cornwall*. Just south of this station contact of the Trenton slates (See Note 142.) and the Archæan rocks of the highlands; the former overturned and dipping beneath the latter. See also Notes 130 and 128.

N. H. DARTON.

Buffalo, New York and Philadelphia, now,			B., N. Y. & P., now W'n. N. Y. & Pa. R. R.,		
Ms.	Western N. Y. & Penna. R. R.	Alt.	Ms.	Rochester Division.—Con.	Alt.
0 Buffalo. ⁴⁰	9 c. Corniferous.	588	47 Tuscarora.	11 a. Portage.	
13 Elma.	10. Hamilton.	827	50 Nunda Ju.	"	
17 Aurora. ⁹²⁵	" & 11 a. Portg.		53 Nunda.	"	
22 Wales.	"		62 Swains.	"	
26 Holland.	"	1176	52 W. Nunda.	"	
29 Protection.	Moraine.	1388	55 Lewis.	"	
36 Arcade. ^{185 1457}	11 a. Por. & 11 b. Chem.		59 Portage.	"	
39 Yorkshire.	Moraine.	1458	64 Wiscoy.	11 a. Por. & 11 b. Chem.	
43 Machias.	"		68 Filmore.	11 b. Chemung.	
50 Franklinville.	11 b. Chemung.	1593	72 Houghton.	"	
57 Ischna.	Vall'y drift.	1541	75 Caneadea.	"	
63 Hinsdale.	"	1501	91 Cuba.	"	
69 Olean. ²⁰¹	Moraine.	1438	99 Hinsdale.	"	
76 Portville.	"	1442	106 Olean. ²⁰¹	" to Conglomer.	
84 Eldred, Pa.	12. Catskill.	1443	0 Olean.	"	
89 Larabees.	"	1481	3 Alleghany.	11 b. Chemung.	
97 Port Allegeny.	"	1482	9 S. Vandalia.	"	
107 Keating Summit.	"	1881	13 S. Carrolton.	"	
121 Emporium. ¹⁰²⁴	{ 14 a. Carboniferous, summit of hills.		19 Salamanca.	"	
Pittsburgh Division. ¹³⁶			25 Red House.	"	
0 Buffalo. ⁴⁰	See Lake Shore R. R.		33 Wolf Run.	"	
10 Hamburg. ¹⁴⁸	"		39 Corydon, (Pa.)	"	
40 Dunkirk.	"		Michigan Central Railway. ¹³⁶		
49 Brocton.	11 b. Chemung.	672	0 Buffalo.	9 c. Corniferous.	
56 Prospect.	"	1221	0 Fort Erie.	"	
63 Mayville.	"	1300	13 Chippawa.	"	
69 Summerdale.	"	1629	16 Niagara.	5 c. Niagara.	
78 Sherman.	"	1568	17 Clifton, (Can'da).	"	
79 Panama.	"	1545	Tonawanda Valley & Cuba Ry. ¹³⁶		
83 Clymer.	"	1146	0 Attica.	11 a. Portage.	
(Continued in Pennsylvania.)			9 Johnsonburg.	"	
Rochester Division. ¹³⁶			13 N. Java.	"	
0 Rochester. ¹³⁷	5 c. Niag. 5 b. Clinton.		19 Curriers.	"	
6 Genesee Ju.	"		26 Arcade.	11 a. Por. 11 b. Chem.	
12 Scottsville.	6. Salina.		36 Fairview.	11 b. Chemung.	
20 Avon. ¹¹¹	9 c. Cornif. 6. Waterli.		59 Cuba.	"	
26 York.	10 b. Hamilton.		30 Sandusky.	"	
29 Pifford.	"		Rochester and Lake Ontario Railroad. ¹³⁶		
33 Cuylerville.	"		0 Rochester.	5 c. Niag. 5 b. Clinton.	
35 D., L. & W. Cros.	"		Lake Beach.	5 a. Medina.	
39 Mt. Morris.	10 c. Genesee.				
41 Senyca.	"				

117. *Tribes Hill*. Good Trenton fossils at quarries and along outcrop. Canastota, Cazenovia and surrounding country excellent ground for *Lamellibrachia* of Hamilton group, and there and at Hamilton best locality for *Homolotus Dekayi*. R. P. WHITFIELD, Curator of Museum of Nat. Hist. of N. Y.

118. *New Hamburg*. Wappinger Creek, entering the River here is bordered for nearly its entire course of thirty miles from Stissing Mountain, mostly on west by ridges of limestone. This belt of limestone, like another one lying further east along the Harlem Railway, traverses the Hudson River shales of the County from N. E. to S. W.; like the shales, it consists of denuded folds, dipping mainly eastward, often forced over so as to overlie the younger slates. These limestones have lately been proved, on the evidence of fossils, to comprise at least the following formations:

1. Strata of associated limestone and quartzose rock, of the Lower Cambrian, containing *Olenellus* trilobites. These are best seen at the bases of Stissing and Fishkill Mountains.
2. Limestones and calcareous shales of Middle Cambrian or *Paradoxides* horizon.
3. The Upper Cambrian, or Potsdam, arenaceous limestones interstratified with calcareous shales and sandstones.
4. A prominent stratum, probably *Califerous*, but containing mostly a new and unique fauna. Its most characteristic locality is Rochdale, four miles northeast of Poughkeepsie.
5. Trenton limestone, with a fauna of Canadian type, shown at Rochdale and Pleasant Valley.

Fonda, Johnstown and Gloversville Railroad.			Ms.	Alt.	Ms. Lehigh and Hudson River R. R.			Alt.
0 Fonda. ¹⁸	4 b. Utica.	299	0 Greycourt. ¹⁸⁰	4 c. Hudson River.				
6 Johnstown.	" Striae.		1 East Chester.	"				
8 Gloversville.	{ 4 b. Utica and	300	3 Sugar Loaf.	"				
	{ 4 a. Trenton.		4 Lake.	4 a. Trenton.	542			
22 Northfie.d. ¹⁸⁰	{ 4 b. Utica and		9 Warwick. ¹⁴¹	"	502			
	{ 1 a. Laurentian.		12 New Milford	"				
Lackawanna & Pittsburg R. R. 136			New York, Susquehanna & West'n R. R. 123					
Olean Division.			71 Quarryville, N. J.	4 c. Hudson River.	142			
0 Olean.	11 b. Chemung.		72 Van Sickles.	"				
4 Gordons.	"		75 Unionville.	"				
6 Postville.	" & Conglom.		78 West Town.	"				
7 White House.	"		81 Johnsons.	"				
10 Ceres.	"		83 Slate Hill.	"				
15 Little Genesee.	Chemung to Conglom.		85 Spring Side.	"				
18 Bolivar.	11 b. Chemung.		88 Middletown.	"				
20 Richburg.	"		West Shore R. R. 143					
29 Friendship.	"		0 Weehawken, N. J.	144 Trias.; Trap dike.	5			
38 Narrow Gage Ju.	"		2 New Durham.	16 Triassic.	4			
44 Angelica.	"		6 Little Ferry.	"	8			
Lackawanna Division. 136			7 Ridgefield Park.	"	6			
0 Nar'w Guage Ju.	11 b. Chemung.		8 E. Hackensack.	"	50			
6 Angelica.	"		9 Teaneck.	"	95			
16 Birdsall.	"		10 W. Englewood.	"	74			
24 Swains.	"		12 Bergen Fields.	"	67			
29 Canaserago.	"		13 Schraalenburgh.	"	82			
37 Rogersville.	"		16 Randalls.	"	46			
41 Wayland.	"		18 West Norwood.	"	52			
0 Swains.	"		19 Tappan, N. Y. ¹⁴⁴	"	74			
10 Nunda.	11 a. Portage.		21 Orangeburgh.	"	93			
12 Junction.	"		22 Blauveltville.	"	122			
Ulster and Delaware Railroad.			24 Nyack T'pike. ¹⁴⁵	"	Trap. ⁵⁶			
0 Rondout. ¹¹⁴	{ 4 c. Hudson Riv. ⁶		26 Valley Cottage.	"	125			
4 Kingston. ¹⁵⁹	{ 6. Water Lime.		29 Congers.	"	178			
9 West Hurley.	7. Lower Helderberg.		33 Haverstraw. ¹⁴⁶	"	75			
12 Olive Branch.	10. Hamilton. ⁵⁴⁴		37 Tompkin's Cove.	147? Slates & limest's. ⁵				
15 Brook's Crossing.	11 b. Chemung.	504	39 Jones' Point.	1 a. Laurentian.	6			
17 Broadhead Bra.	11 a. Portage.		41 Iona Island.	"	7			
18 Shokan. ⁵⁸⁷	"	504	43 Fort Montgomery.	"	8			
21 Boiceville.	11. Chem. & 11. Cats.		47 Cranston's.	"	8			
24 Mount Pleasant.	12. Catskill.	604	48 West Point.	"	8			
27 Phoenicia. ³⁰⁶	"	796	52 Cornwall. ¹¹⁶	4 c. Hud. Riv. ¹⁴²	10			
32 Fox Hollow.	"	1004	57 Newburgh. ¹⁸⁸	{ Hudson Riv. and	28			
33 Shandaken.	"	1072		{ Cambro-Silu. limest.				
36 Big Indian.	"	1218	61 Clark's Dock. ¹⁴⁹	{ 3. Lower Silurian	10			
39 Pine Hill. ¹⁶⁷⁹	{ " Lowest Pass		65 Marlborough. ¹⁵⁰	limestones.	10			
44 Griffin's Corners.	{ of the Catskill Mts.		68 Milton.	4 c. Hudson River.	10			
48 Dean's Corners.	12. Catskill	1504	72 Highland.	4 c. Hud. Riv. Group. ⁹	9			
51 Kelly's Corners.	11. Chemung.		78 West Park. ¹⁵¹	"	108			
53 Halcottville. ²⁰⁸	"	1378	80 Esopus. ¹⁵²	"	118			
57 Straton's Falls.	"	1408	83 Ulster Park.	"	145			
59 Roxbury. ³⁰⁸	12. Catskill.		88 Kingston. ¹⁵³	9 c. Corniferous.	182			
65 Moresville.	"	1501	95 Mt. Marion. ¹⁵⁴	"	159			
74 Stamford. ²⁰⁹	"and Chemung.		99 Saugerties. ¹⁵⁴	9 a. Cauda Galli.	158			
	"	1771	108 West Camp. ¹⁵⁴	4 c. Hudson River.	118			

This limestone crosses the Hudson River obliquely in two strips, between Hampton, (just south of Marlborough), and Danskammer Point. At the north end of the New Hamburg tunnel, the limestone is well shown overlying, by inversion, the Hudson River shale.

The shales throughout this County are mainly of the Hudson River Group, with here and there Graptolitic layers, which are by some geologists assigned to the Utica slates. W. B. D.

Ms.	West Shore.—Con.	Alt.	Ms.	West Shore.—Con.	Alt.
110	Catskill. ¹⁸⁸	4 c. Hudson Riv. ? 98	255	Wampsville.	5 c. Niagara. 450
115	West Athens.	" 127	257	Canastota.	6. Salina. 433
120	Coxsackie.	" 137	261	Canaseraga.	" 417
125	New Baltimore.	" 135	264	Chittenango.	" 410
128	Coeyman's Ju.	" 177	268	Kirksville.	" 420
133	Selkirk.	" 143	270	Manlius Centre.	" 410
141	Albany.	" 18	274	Dewitt.	" 410
128	Coeyman's Ju.	"	278	Syracuse.	" 399
132	S. Bethlehem.	" 202	285	Amboy.	" 402
136	Feura Bush.	" 225	288	Warners.	" 423
	New Scotland.	" 297	290	Memphis.	" 405
142	Voorheesville.	" 327	295	Jordan.	" 393
146	Guilderland.	" 312	300	Weedsport.	" 423
147	Fullers.	" 266	303	Port Byron.	" 399
152	S. Schenectady.	" 346	307	Montezuma.	" 389
	Saratoga.	4 a. Trent. & 3 a. Calc.	309	Seneca River.	"
160	Rotterdam Ju.	4 b. Utica. 237	311	Savannah.	" 403
161	Pattersonville.	" 270	317	Clyde.	" 389
168	Port Jackson.	4 a. Trenton. 281	324	Lyons.	" 403
173	Fort Hunter.	" 294	329	Newark.	" 433
174	Auriesville.	" 303	333	Port Gibson.	" 430
178	Fultonville.	4 b. Utica. 302	338	Palmyra.	" 436
183	Downing.	" 296	341	Macedon.	" 472
187	Sprakers. 309	{ 1 a. Laur. capped by 8 a. Calcifer. hills.	349	Fairport.	" 449
193	Canajoharie.	4 a. Trenton. 302	353	Pittsford.	" 470
194	Fort Plain. 306	4 a. Birdseye, 4 a. Tren.	356	Edgewood.	" 500
199	St. Johnsville.	4 c. Hudson River. 327	360	Red Creek.	" 542
200	Mindenville.	" 321	362	Genesee Ju.	5 c. Niagara. 525
204	Indian Castle.	" 329	367	Rochester.	"
209	Little Falls.	1 a. Laurentian. 322	368	Maplewood.	" 535
212	Jacksonburgh.	" 328	365	Chili.	" 549
217	Mohawk.	4 b. Utica. 396	368	Buckbees.	" 563
219	Ilion.	" 390	372	Churchville.	6. Salina. 567
221	Frankfort.	" 393	374	Bergen.	" 580
225	W. Frankfort.	" 403	381	Byron.	" 615
229	E. Utica.	" 497	387	Elba.	" 760
231	Utica.	" 513	392	Oakfield.	" 765
238	Clark's Mills.	4 c. Hudson River. 516	398	Alabama.	" 710
242	Heckla.	5 a. Medina. 627	404	Akron.	9 c. Corniferous. 673
247	Vernon.	5 b. Clinton. 595	410	Clarence.	" 706
252	Oneida Castle.	5 c. Niagara. 453	415	Bowmansville.	" 695
			423	E. Buffalo Ju.	" 620
			426	Buffalo. ¹⁴³	" 579

119. *Poughkeepsie*. From the north end of the New Hamburg tunnel, with the exception of a short strip of Potsdam limestone a little south of Camelot, Hudson River shales and grits occupy continuously the east bank of the River as far as Rhinecliff and beyond, passing under the city of Poughkeepsie. Also they form the west bank from Hampton to Rondout. At several points there appear, without any definite divisional lines, layers of graptolitic shales which some geologists consider characteristic of the Utica Slate. Such layers occur in the R. R. cuts at the dock opposite the N. Y. State Hospital for the Insane, and at West Park on the west bank above the City.

At a point immediately south of the Driving Park, and on the Spaenckill road are localities of fossiliferous Potsdam. At the first point there is a conspicuous fault between the Potsdam and Hudson River Groups, which continues three miles southeasterly, striking the river in a bold bluff south of Camelot. Here are extensive and valuable beds of moulding sand, which are evidently in part at least derived from the disintegration of the Potsdam arenaceous limestone. This fault is a part of the great system of faults described in Note 8. W. B. D.

120. *Schojack Landing*. The Hudson River shales in the neighborhood abound in graptolites and about a mile and a half south are overlaid in apparent conformity by schists and limestones, containing fossils of the Lower Cambrian group, the latter rocks making the third promontory along the R. R. track south of the station. When the foliage is absent, the line of contact of the two groups can be seen from the cars. S. W. Ford.

121. *Albany*. Two miles below Albany at Kenwood in ravine near Knitting Mill is the famous locality for the Norman's Kill graptolites in Utica Slate. Beds nearly covered by buildings at present. The bed is seen near the middle of D. & L. R. R. cut. R. F. W.
Champlain deposits here. T. C. Chamberlain.

Ms. New York City & Northern R. R. 156 Alt.			N. Y. Central and Hudson River R. R.		
			Ms. Harlem Division. 162, 174, 175, 176. Alt.		
0	155 Street.	178	0	New York.	See Note 4.
1	High Bridge.		9	Fordham.	Middle Laurentian.
8	South Yonkers.	Limestone. 145	11	Williams Bridge.	Limestone.
11	N. Yonkers.	" 164	14	W. Mt. Vernon.	"
18	Odells.	" 119	16	Bronxville.	"
15	Ashford.	"	17	Tuckahoe.	" Marble.
18	Elmsford.	"	20	Scarsdale.	"
20	E. Tarrytown.	"	22	White Plains.	Middle Laurent'n. 202
21	Tarrytown.	"	31	Pleasantville.	Limestone. Marble.
23	Tarrytown Hts.	" 387	33	Chappaqua.	"
27	Whetson's.	"	37	Mount Kisco.	Middle Laurentian.
30	Merritts Cors.	" 346	40	Bedford.	291 " Feldspar pro-
32	Croton Lake.	"	45	Golden's Bridge.	Highlands. " duced for pot-
37	Yorktown.	" 439	47	Purdy's.	" teries. 356
38	Amawalk.	" 384	48	Croton Falls.	"
39	West Somers.	" 517	53	Brewster's.	414 L. Laure. Iron ore W.
42	Baldwin Place.	" 621	56	Dykeman's.	" on summit.
44	Mahopac.	Lower Laurentian. 641	61	Patterson.	Camb. Silurian l. s.
47	Crafts.	" 482	64	Pawling.	"
49	Carmel.	" 519	71	South Dover.	415 " Iron ore W.
52	Tilly Foster Mines	" 401	76	Dover Plains.	" Limest. on E.
54	Brewster.	" 406			

122. The limestones and sandstones used for flagging and building in the various cities along the line of the N. Y. C. & H. R. R. R., are as follows: At Albany and Schenectady, 4 c. Hudson River; Utica and Rome, 4 a. Trenton limestone, generally of the Birdseye portion, which produces the thickest stone; at Syracuse, Auburn and Geneva, the 9. Upper Helderberg, generally the Onondaga or lower portion of it; from Rochester to Buffalo the 5 a. Medina sandstone is the favorite for these purposes. Some 5. Niagara limestone are used at Rochester and 9 Upper Helderberg or Corniferous at Buffalo, especially for lime burning. But the best flagstones are from the Hamilton and Chemung formations, and generally come from the shores of Cayuga Lake. Large quantities of flagstones are also brought from the upper part of the Hamilton group in the higher parts of the Helderberg, and from the same geological position along the west side of the River Hudson from below Catskill as far as Kingston.

123. By Mr. Nelson H. Darton, of the U. S. Geological Survey. Mr. Darton prefers to use the term 4 a. Trenton rather than Hudson River for the wide areas of slates in Orange and adjacent counties, which contain a mixed Hudson River and Trenton limestone fauna, but for the sake of uniformity Hudson River is used throughout the chapter.

124. *Meadow Brook*. About three-fourths of a mile east, the railroad crosses the ridge described in note 123. The red grits near this station are the same as those in the ridge there described, brought up by a synclinal.

125. *Caledonia* and *Stafford*, two of the best places in the State for silicified Upper Helderberg corals. Akron also. Excellent corals at Le Roy.

126. *Cornwall*. Just west of this station is a ridge composed of red and grey conglomerates similar to those near Highland Mills and probably near Oneida in age. It is flanked on the western side by Lower Helderberg limestone from the Waterlime to the Delthyris shaly limestone, the latter holding a bed of Limonite and plentiful fine casts of about a hundred varieties of fossils. The occurrence of this fossiliferous rock so far from the main mass of the formation is very interesting. See also Note 124.

127. *Passaic*. South of this station the pallasdal front of the First Watchung or Orange Mountain is in sight. This long canoe-shaped ridge and some others behind it to the west and south are capped by the outcropping edges of great sheets of basalt lavas, which were outpoured at intervals on the floor of the Triassic sea during the deposition of the formation. The upper surfaces of these sheets, when not too deeply eroded, are deeply vesicular and at some points they are exposed in contact with unaltered shaly sediments. The more or less vesicular and altered bases of these sheets lie with perfect conformity on the shales, which often extend for some distance up the steep sides of the ridges and dip at low angles westward. Basal contacts in the quarries on the ridge slopes southeast of Paterson may be seen from the cars and are fine exposures in the deep gorge, into which the Passaic River falls in crossing the First Watchung ridge in Paterson.

128. *Turner's*. On emerging from the highlands north of Greenwood the line of the road passes over a broad valley encircling and extending northeastward from Turner's, and is in greater part underlain by limestones of undetermined, but probably Lower Silurian age, and by slates of Trenton age.

129. *Monroe*. A mile west of this station a synclinal holding Middle Devonian is crossed, but no outcrops are visible from the cars. These rocks extend for many miles southward into New Jersey. In New York they form Bellvale Mountain to the Erie R. R. and thence extend northward in the high, rough, double crested ridge known as Schunemunk Mountain. The lower members are flagstones and slates, the upper a coarse pebble conglomerate. In a flagstone quarry, two miles N. N. W. of Monroe, the remains of Devonian plants are quite abundant. In the valley westward the series is underlain by a white Quartzite succeeded by limestone holding an Upper Silurian fauna and an unfossiliferous limestone lying on Gneiss. The two last are exposed in the railroad about a mile east of Oxford. This gneiss is flanked on the west by an inconsiderable thickness of limestone which is overlaid by the slates which are thence exposed nearly to Oxford. N. H. D.

N. Y. Central & Hudson River R. R.—Con.			Ms. N. Y., New Haven & Hartford R. R. Alt.		
Ms.	Harlem Division.—Con.		Alt.		
82	Wassaic.	Cam.-Sil. Schists.		0 New York. ¹⁷⁸	See Note 4.
84	Amenia.	" " l. s.		12 Williams Bridge.	"
87	Sharon.	" " "Burd'n's gun		15 Mount Vernon.	{ 1 d. Montalban,
98	Millerton. 702	" " "bar'l iron ore W		18 New Rochelle.	probably. 70
97	Mount Riga.	" " l. s. (Summit).		22 Mamaroneck.	"
100	Boston Corners.	" " "Iron ore W.		25 Rye.	"
106	Copake.	" " "Iron Works.		27 Port Chester.	"
109	Hillsdale. 671	Cambro-Silurian.		30 Greenwich.	"
116	Martinsdale.	" "		31 Cos Cob Bridge.	"
120	Philmont.	" "		35 Stamford, Conn.	"
126	Ghent.	" "		Harlem River Branch.	
127	Chatham.	" "		0 Harlem River.	Montalban or Meta-
All the iron ore is produced on the west side— none on the east side of railroad.				1 Port Morris.	morphic. See Note 4.
N. Y., Rutland & Montreal Ry.				5 West Chester.	"
0	Chatham 4 cor.	4 c. Hud. Riv. Group.	See Notes 174-76-76.	12 New Rochelle.	"
5	Chatham.	"		Middletown Branch. 164	
11	Rider's Mill.	"		0 New Britain.	16 Triassic.
18	New Lebanon.	"		3 Berlin.	"
27	Lebanon Springs.	"		13 Middletown.	"
31	N. Stephantown.	"			
34	Centre Berlin.	"			
39	Berlin.	"			
44	Petersburg.	"			
45	N. Petersburg.	"			
47	T. & B. Junction.	2. Cambrian sl.			
53	Bennington, Vt.	3. Lower Silurian l. s.			

130. *Graycourt*. West of the Oxford limestone to the Blue, or Shawangunk Mountain, at Otisville there is a rolling country underlaid by Slates, which have been recently found to be Trenton in age. (See Note 142.) They extend northeastward to the Hudson River and south across part of New Jersey. They are underlaid by limestones, which hold Lower Silurian faunas. N. H. D.

131. *Suffern*. A short distance east is Union Hill composed of a thin sheet of trap lying upon heavy beds of Conglomerate. N. H. D.

132. *Sparkill*. At many points south of here overlying strata are found in contact with Palisade trap sheet, as stated in Note 5. North of this station the R. R. crosses the sheet and skirts the east side of the ridge at a considerable altitude. The under contact of trap and sandstone maybe found near Piermont-on-the-Hill, and near Grandview, above the R. R. N. H. D.

133. *Homestead*. See Note 5. This road crosses the Palisade trap ridge in the Erie tunnel and skirts its western base to Sparkill where it recrosses to Piermont. A few hundred yards S. E. of the station, and in sight from the cars, contact of trap and overlying shales is exposed in a small quarry. N. H. D.

134. *New Durham*. Three-fourths of a mile east in a cut at entrance to W. S. R. R. tunnel the dike structure of Palisade trap is exposed at unconformable contact with overlying sandstones. N. H. D.

135. *Granton*. A short distance north is a small dike and sheet of trap separated from the Palisade sheet by a slight thickness of sandstone. N. H. D.

136. By Prof. H. S. Williams, of Cornell University.

137. *Rochester*. Shales below falls filled with corals and *Brachiopods* of Niagara group. Entire Clinton exposed and many layers filled with excellent fossils. Several beds of graptolites known by the black color of the seam. Lower fall gives limestone filled with *Pentamerus Elongatus* and below Medina sandstone with *Fucoides*, etc. R. P. WHITEFIELD.

See Note 36 and Glacial Note 181.

138. *Newburgh*. The city rests upon strata which are evidently similar to those identified in Dutchess County. The entire water-front is composed of Hudson River shale, while that part of the city west of West street is on the belt of limestone which crosses the river from New Hamburg in Dutchess County. On the river road three miles north of the city, there are highly fossiliferous ledges of the Trenton group, containing the Coral *Solenopora Compacta*, and very large Crinoid columns. With this exception this great belt of limestone from Hampton to Long Pond appears to be entirely without fossils. A comparison with the more northern extension of the belt makes it probable that besides the Trenton, Calciferous and Cambrian strata are present. Snake Hill to the south and Cronomer's Hill to the west, are Archean gneiss. W. B. D.

139. *Mt. Joy*. Road crosses Palisade trap sheet.

140. *Eagle Bridge*. At Eagle Bridge, Cambridge and Granville, the railroad passes over a narrow strip of Hudson River Shales flanked on either side by broad masses of Lower Cambrian or "Georgia" shales and limestones, which are not more than a mile distant, or less. At Salem a broad belt of Hudson River shale lies a short distance to the west. Fossiliferous localities of the Lower Cambrian have been found near Shushan, Salem, Rupert and Granville. (Some of the chief localities described are one mile south of Shushan one and one-half miles east and west, and one mile south of N. Greenwich (near Salem) two miles south of North Granville, and at Low Hampton, just west at the crossing of Poultney River.) W. B. D.

Ms.	Boston and Albany Railroad.	Alt.	Ms.	Hartford & Conn. Western R. R.	Alt.
0	Albany.	4 c. Hudson River. ³²	0	Rhinecliff.	4 c. Hudson River.
1	Greenbush.	" ²⁴	3	Rhinebeck.	"
9	Schodack. ²⁰⁸	Doubtful, ^{174, 175 & 176}	7	Red Hook.	2-4 Camb. Sil. Schists.
17	Kinderhook.	" ²¹⁸	11	Spring Lake.	"
20	Chatham Centre.	" ²¹⁵	17	Jackson Corners.	"
24	Chatham. ¹⁶⁸	4 c. Hud. Riv. Gr'p. ⁴⁶²	25	Ancram.	"
29	East Chatham.	" ⁶⁹¹	35	Boston Corners.	3-4 Camb. Sil. Limest.
34	Canaan. ¹⁷⁸	" ⁸⁶⁹	42	State Line.	"
39	State Line.	" ⁹¹⁴		See Connecticut.	
	(Continued in Massachusetts).			Newburgh, Dutchess & Conn. Railroad. ¹⁶⁴	
	Hudson & Chatham Branch.		0	Dutchess Junc.	4 c. Hud. Riv. Group.
0	Hudson.	4 b. Utica.	2	Matteawan. ¹⁷⁰	" ¹¹⁹
4	Claverack.	Doubtful.	4	Glenham. ¹⁷⁰	" ²¹⁸
9	Millerville.	"	6	Fishkill.	Calcoif.-Trent. (?) l's. ²¹⁸
11	Pulver's.	"	11	Hopewell.	" ²⁵²
15	Ghent.	"	13	Clove Branch Ju.	" ²⁸⁹
17	Chatham.	4 c. Hud. Riv. Group.	17	Sylvan Lake.	"
	New York & Massachusetts R. R. ¹⁶⁴		19	Billings.	4 c. Hudson River. ²⁹¹
0	Poughkeepsie. ¹¹⁹	4 c. Hud. Riv. G'p. ¹⁷⁹	25	Verbank.	" ⁵⁵³
6	Pleasant Val. ¹⁶⁸	4 a. Trenton.	30	Millbrook.	" ⁵⁶⁶
11	Salt Point. ¹⁶⁸	4 c. Hud. Riv. Group.	37	Bangall. ¹⁷¹	"
13	Clinton Cors. ¹⁶⁷	4 c. Hud. Riv. Shale.	40	Stissing Junc.	" ⁴⁸⁷
16	Willow Bro'k. ¹⁶⁸	Cambri. (?) limestones.	45	Pine Plains.	Cambrian (Upper?) ⁴⁷⁰
18	Standfordville.	4 c. Hu. Riv. Shale. ²²³	47	Bethel.	3 a. Calcoiferous.
20	McIntyre.	Calcoiferous limestone.	50	Shekomeko. ¹⁷²	{ Calcoiferous and ⁵⁰⁸ Upper Cambrian.
21	Stissing. ¹⁶⁹	2 a and 2 a Cambrian.	52	Husted.	Cambrian (Upper?)
27	Pine Plains. ⁴⁷⁰	2a and 2 (?) Cambrian.	54	Winchell's.	4 c. Hudson River. ⁶⁶⁷
31	Ancram L'd. Ms.	" ⁵⁷⁰	59	Millerton.	Calcoiferous-Trent. ⁷⁰²
37	Boston Corners.	" ⁷³³			

141. *Warwick*. At Edenville, four miles west, compare the "blue limestone" of Primordial or Lower Silurian age with the "white limestone" of the Archæan, which there crop out in parallel and almost contiguous ridges. The Archæan limestone is highly crystallized and contains many crystals of foreign matter. W. B. D.

142. This series of slates, occupying large areas in Orange County, New York, and extending southward into New Jersey, contains a mixed Hudson River and Trenton limestone fauna, and should perhaps be designated Trenton. (See Note 123.) N. H. D.

143. West Shore R. R. Stations from Weehawken to Nyack Turnpike are by Prof. W. B. Dwight of Vassar College, thence to Cornwall by Mr. Nelson H. Darton, U. S. Geologist, thence to Esopus by Prof. Dwight, and thence to Albany by Prof. Dwight and Hon. James G. Lindsey of Rondout. From Albany to Buffalo the tables are by Prof. H. S. Williams of Cornell. On this portion see notes on New York Central, running nearly parallel.

144. For stations in N. J. see also New Jersey Chapter.

145. *Nyack Turnpike*. From some distance south of this station and thence northward, this road skirts the western side of the palisade trap sheet, and crossing it in a tunnel north of Congers, follows its eastern side to Haverstraw, where the high ridge formed by the trap, curves westward to the highlands. In the cut at the southern end of the tunnel the highly altered sedimentary beds are exposed, abutting against the steep trap dike, while on the east side of the ridge, they are exposed dipping gently beneath the trap, indicating the dike and sheet structure described in Note 5. N. H. D.

146. *Haverstraw*. One mile north of the station there is a cut through 16. Triassic calcareous conglomerate. A few hundred feet farther, on Stony Point, the deep cut gives fine exposures of some members of the Cortland series of intrusives and metamorphics. N. H. D.

147. *Tompkin's Cove*. Extensive quarries of blue and grey limestones near station. Age of the beds uncertain but probably Lower Silurian. They are separated from the Archæan rocks of the highlands by black slates of unknown age, which are exposed at many points in this vicinity and southward to Pompton, N. J. N. H. D.

148. *Hamburg*. Eighteen Mile Creek and vicinity are most excellent localities for Hamilton fossils, along lake shore and up stream a short distance and also at Hamburg in cutting on R. R. (R. P. W.)

Sub-aqueous drift; lake terraces along the lake shore to Ashtabula. (CHAMBERLIN.)

149. *Clark's Dock*. Interesting clay beds of the Champlain Period deposited in the form of three inverted, truncated cones, instead of horizontally, as is usual in the beds lining both banks of the Hudson. W. B. D.

150. *Marlborough*. Hampton Point, three quarters of a mile south is the northern edge of the limestone belt crossing from Dutchess County, (See Note 118.) and passing to the west of Newburgh. Here Kerr's Hydraulic Cement Works are now in successful operation. The limestone is apparently Cambrian with perhaps Lower Silurian. See Note 138. W. B. D.

151. *West Park*. On the north side of a railroad cut just south of Hazen's (or Adam's Dock), and between one and two miles south of the railroad station, slabs of slate covered with excellent graptolites, may be obtained. These are referred by Prof. Whitfield to the Utica slate; by some other geologists to the Hudson River Group. W. B. D.

Ms. New York & New England R. R. 164 Alt.			Ms.	Troy and Boston.—Con.		Alt.
0	Newburgh. ¹⁸⁸	4 c. Hudson River.	26	Hoosic Junction.	4 c. H. Riv. & Georgia.	
1	Fishkill. ¹¹⁸	"		State Line.	{ 4 c. Hud. Riv. and	
4	Matteawan. ¹⁷⁰	"			Calcif.-Chazy-Tren.	
8	Fishkill Village.	Calcif.-Trent. l's. ²¹³	27	Hoosic Falls.	4 c. Hudson River.	
10	Brinkerhoff.	" ²²³	30	Hoosac.	{ 4 c. Hud. Riv. and	
14	Hopewell.	"			Calcif.-Chazy-Tren.	
19	Stormville.	"	32	Petersburg.	Calcif.-Chazy-Trent.	
22	Poughquag.	"	36	North Pawnee.	" " "	
25	Pawling.	"	43	Williamstown. ¹⁶³	" " "	
31	Patterson.	Laurentian.	45	Blackinton.	{ Hudson River and	
38	Towners.	" ⁴³²			Calcif.-Chazy-Tren.	
38	Brewster.	" ⁴⁰⁶	48	North Adams.	Calcif.-Chazy-Trenton.	
44	Mill Plain.	"				
Troy and Boston Railroad. 164 (Fitchburg Railroad.) 163			Greenwich and Johnsonville Railroad. Washington Co. 164			
0	Troy.	Hud. Riv. and Georgia.	9	Johnsonville.	4 c. Hudson River.	
4	Lansingburgh.	"	5	Lee's.	"	
9	Melrose.	"	6	S. Cambridge.	"	
18	Schaghticoke.	" Trenton?	8	W. Cambridge.	"	
14	Valley Falls.	4 c. Hudson River.	10	Summit.	"	
17	Johnsonville.	"	13	Easton.	Lower Cambrian.	
21	Buskirk's.	4 c. H. Riv. & Georgia.	16	Greenwich.	"	
24	Eagle Bridge.	"				

152. *Esopus*. On leaving the river in *Esopus*, before crossing Rondout Creek, going north, the road crosses the ends of a synclinal arch; the first rock is nearly vertical section of Niagara, then Waterlime-Pentamerus, Catskill Shaly, Upper-Pentamerus, Catskill-Shaly, Pentamerus, Upper Pentamerus. After crossing the creek, the road enters a tunnel the south end of which is Catskill Shaly, the middle section Upper Pentamerus and the north and Oriskany, all nearly vertical. After the tunnel is passed the Cauda Galli is entered and perhaps Schoharie Grit, and then Corniferous and it may be the Onondaga. J. G. L.

153. *Kingston*. Unconformability of Lower and Upper Silurian well shown here. Remarkable contortions of strata. Fossils abundant. At Rondout, now included in the city of Kingston, are seen Hudson River Group; Oneida; Coralline limestone of Niagara Group; all the divisions of Lower Helderberg; Oriskany; Cauda Galli and Corniferous; all but the last two quite fossiliferous. At old Kingston, on *Esopus* Creek, Marcellus and Hamilton. Immense cement quarries in Helderberg limestones.

See "Non-conformity at Rondout" by W. M. Davis, Am. Journ. Science, November, 1883.

W. B. D.

Station is on terrace of Alluvium and Drift overlying Corniferous, which crops out in a high ridge to the eastward, dipping to the northwest. To the west bluff of Marcellus overlying Corniferous. J. G. L.

154. *Mount Marion*. The road (going north) continues on Corniferous nearly to Saugerties, where it comes again to the Cauda Galli and, before it reaches West Camp, it passes back over all the intervening layers to the Hudson River which it does not leave, except a few cuts into the Waterlime between West Camp and Catskill. J. G. L.

At Glenerie a little over a mile southeast from Mount Marion station along the east bank of Saugerties Creek, are abundant exposures of Oriskany, crowded with finely weathered fossils. W. B. D.

155. *Catskill*. The Helderberg rises sharply to the west nearly all the way to Coeyman's.

156. By Prof. C. H. Hitchcock.

157. *Canandaigua*. Go up the lake six miles to Monteth's Pt. up ravine, most excellent Hamilton fossils, all classes. Also all along lake shore to Black Pt. Heads of Monteth's ravine, Genesee slate with plants, and gas springs. R. P. W.

158. *Knowltonville and Guilderland*. Go up mountain to first plateau, rocks filled with Lower Helderberg fossils. *Tentaculites* and *Leperditia* at base of vertical layers. Thompson's Lake one and a half miles back from top of bluff at Indian Ladder road, Schoharie grit and Upper Helderberg fossils. Also Clarksville 12 miles southwest of Albany has yielded immense numbers of Lower Helderberg Bryozoans and Corals. R. P. W.

159. *Schoharie*. In the hill east and west from the village the entire Helderberg series occurs, and fossils are numerous in the Coralline limestone. Lower Helderberg, Oriskany sand, Schoharie grit and Upper Helderberg. R. P. W.

160. *Darien*. Best locality in the state for Hamilton in streams at Darien City, and also two miles west of Darien Centre in small stream at Milldam, and for one mile below slate road Corals and Shells. R. P. W.

161. The formations are given on this road approximately, no definite information having been published. From Dannamora to Lynn Mt. both the Laurentian and the Potsdam are given, implying that both strata are in the neighborhood. W. B. D.

162. Revised by Prof. C. H. Hitchcock. From Pawling to Chatham Prof. Dwight prefers "Calciferos" or "Calciferos-Trenton." This limestone, he says, is the eastern fork of the Copake-Hilldale belt of which the Wappinger Valley limestones are the western fork. Calciferous fossils occur in it. Cambrian strata may be present. At North East Center, one and one-half miles south of Millerton, Calciferous fossils occur on Edward Clark's farm.

Ms. Ogdensburg & Lake Champlain R.R. Alt.		Ms. Catskill Mt. & Cairo Railroad. 164 Alt.	
0 Ogdensburg.	3 a. Calcif. 20 ms. 1855	0 Catskill Landing.	4 c. Hudson River.
9 Lisbon.	"	1 Catskill.	7 Low. Helderberg l's.
17 Madrid.	"	8 S. Cairo.	"
25 Norwood.	"	14 Mountain House.	"
28 Knapps.	2 b. Potsdam, 53 ms.	16 Palenville.	"
86 Brasher Falls.	"	Stony Clove and Catskill Mt. Railroad. 164	
41 Lawrence.	"	0 Hunter.	12. Catskill s. s.
47 Moira.	"	2 Kaatersville Ju.	"
55 Bangor.	"	4 Stony Clove.	"
61 Malone.	"	6 Edgewood.	"
73 Chateaugay.	1 a. Laurentian, 5 ms.	9 Lanesville.	"
81 Cherubusco.	2 b. Potsdam, 36 ms.	12 Chichesters.	"
89 Ellenburg.	"	14 Phoenecia.	"
90 Dannemora.	" 1856	Kaatersville Railroad.	
97 Altona.	"	0 Kaatersville Ju.	12. Catskill s. s.
103 Mooer's Forks.	"	8 Kaatersville.	"
106 Mooer's Junction.	3 b. Chazy.	Long Island Railroad.	
114 Champlain.	3a. Cal. & 3b. Chazy, 4ms	0 Hunter's Point.	20. Quarternary, with
118 Rouse's Point.	3 b. Chazy, 2 miles.	10 Jamaica.	Tertiary or Creta-
122 Alburgh.	4 b. Utica, 13 miles.	19 Mineola.	ceous.
126 Alburgh Springs.	"	25 Hicksville.	"
138 Swanton.	4 c. Hudson River.	29 Syosset	"
136 Swanton Junc.	"		
142 St. Albans, Vt.	2 b. Potsdam, 6 miles.		

163. *Williamstown*. An important point in the typical area of the original Taconic Series. Recent researches of laborious stratigraphic and paleontological field-work, have at last resulted in securing, in general, a well-assured stratigraphy for this entire Taconic region including the great synclinals of limestones, shales, schists and quartzites of the central mountain ridges and the adjacent rolling country on the east and west flanks. The most recent and extensive discoveries of fossils were made by Mr. C. D. Walcott in 1887 and in one or two years previous. Stratigraphic maps have been lately published by Prof. J. D. Dana, and by Mr. Walcott. These show beyond question that the main central ridges of Taconic rocks consist of Potsdam, Calciferous, Chazy, Trenton and Hudson River strata, flanked on the east by a belt of Potsdam and pre-Cambrian rock, and on the west by a wide belt of Lower Cambrian somewhat intermixed with Hudson River Shales.

Some of the principal localities of fossils are at Pownal, and three miles south of Bennington, Vt., north side of Graylock Mt., Mass. near Hoosac, and Hoosic, N. Y. and at other points for which see Note 140. W. B. D.

164. By Prof. W. B. Dwight, of Vassar College.

165. *Pleasant Valley*. Fossiliferous Trenton in cut near north of depot and in quarry, one half mile south. Calciferous limestone in ridges west of the Trenton, at quarry, etc. Fossiliferous Potsdam limestone a little northwesterly from railroad station. Hudson River shales on each side of the belt of these limestones. About half way between this and Salt Point fossiliferous Potsdam mainly composes hill on east side of the railroad near the school house. W. B. D.

166. *Salt Point*. Limestone belt passes to east of depot through Hudson River shales. At Clinton Corners passes west of station. Exposure of Trenton and Calciferous limestone with a little Potsdam at Wallace's quarry one mile south of Salt Point. W. B. D.

167. *Clinton Corners*. Limestone of Potsdam and Calciferous groups occurs northwest of station.

168. *Willow Brook*. A ledge of quartzite of Lower Cambrian occurs near the station to the southwest and some of the limestone may belong to the same horizon.

169. *Stissing*. Station stands on one of the Wappinger limestones, which appears in place in a little gully near track and in cuts to the north and south. Being without fossils its age is uncertain, but probably either Potsdam, Rochdale or Trenton. Between this limestone and the base of Stissing Mountain (Archean gneiss) is a strip of red shale of the Olenellus group. On ascending the southern slopes of the Mountain, the red shale is succeeded by an underlying stratum of limestone of the "Olenellus" group, containing *Hypothyridellus Mearns*; underlying this a little higher up the declivity is quartzose rock also of the "Olenellus" group and immediately overlying the gneiss. In some spots this quartzite is ferruginous and highly fossiliferous containing *Olenellus asaphoides* and other fossils. W. B. D.

170. *Matteawan and Glenham*. The stations (Newburg, Dutchess and Conn.) stand on shales of the Hudson River Group, which near Glenham become in some localities greenish and also bright purplish red. Ledges of an impure irregular granite appear at some points near Fishkill Creek surrounded by shales or limestones. On the southern side of the creek in Matteawan and Glenham are conspicuous ridges of limestone belonging to the Wappinger Valley series, but not yet exactly determined by fossils. On farm of Mr. Charles M. Wolcott, southwest from Matteawan and three miles from the Hudson River, quartzite of the Lower Cambrian crops out, immediately overlying the gneiss rock of Fishkill Mountain. W. B. D.

171. *Bangall*. A broad belt of Calciferous and Cambrian limestones stretches northerly from Bangall for about a mile and a half along the Hull's Mills road; the Calciferous is quite fossiliferous at some points. In this vicinity there are numerous faults between the Hudson River Group, and the two stratigraphic components of the limestone. W. B. D.

Ms.	Long Island Railroad.—Con.	Alt.	Ms.	Long Island Railroad.—Con.	Alt.
24	Huntington.	20. Quarternary, with	10	Jamaica.	20. Quarternary.
40	Northport.	Tertiary or Cretaceous.	16	Valley Stream.	"
59	Port Jefferson.	"	19	Ocean Point.	"
30	Farmingdale.	"	21	Far Rockaway.	"
65	Manor.	"	25	Sea Side House.	"
94	Greenport.	"	22	Freeport.	"
0	Hunter's Point.	"	36	Babylon.	"
3	Woodside.	"	47	Oakdale.	"
4	Winfield.	"	54	Patchogue.	"
5	Newtown.	"	Staten Island Railroad.		
8	Flushing.	"			
9	College Point.	"	0	Stapleton.	{ 18 c. Cretaceous. (Plastic clay formation.)
11	Whitestone.	"		Richmond.	"
14	Brookdale.	"	11	Pleasant Plains.	"
0	Brooklyn.	20. Quarternary.	18	Tottenville.	"
8	Richmond Hill.	"			

172. *Shekomoko*. An independent strip of limestone about six miles long extends from "Th. Square" two mile south of Shekomoko, up the valley to Pulver's Corners. It consists of Calcareous, and probably the Potsdam, which runs frequently into calcareous shales. At Husted Station, the latter formation skirts the west flank of Winchell's Mountain, and is well shown in a deep cut just north of the station. In a cut south of the Shekomoko Station is a conspicuous fault between the Calcareous and Hudson River Group, and a little further south, the Calcareous contains fossils.

173. *Canaan 4 Corners*. The limestone belt between Canaan 4 Corners and State Line Station, which with the overlying argillaceous and arenaceous rocks, formed a portion of the original "Taconic Series" of Emmons, have recently been shown by indisputable paleontological evidence to belong, in part at least, to Lower Silurian formations. Fossils have been recently discovered at the railroad tunnel (No. 290) and south of it, also on Drowne's farm one mile east of Canaan 4 Corners. These fossils indicate certainly Lower Silurian strata, probably of the Trenton and Calcareous groups. See note 163.

Geology of Eastern New York.

174. The geology of the country between the Hudson River and the Connecticut and Massachusetts State Line was involved in almost entire obscurity until within a few years. In the State geological survey of forty-eight years ago, the slates were assigned, for stratigraphic reasons, to the Hudson River Group, and the limestones without any evidence of any value derived from fossils, was assigned to the Calcareous and Trenton groups. Afterwards, the entire mass of rocks was indefinitely assigned to the Quebec Group and was so designated in the first edition of this *Guide*. The difficulty of ascertaining the true order was much increased from the fact that the strata are much metamorphosed, flexed and faulted.

It is now known, on abundant paleontological evidence, that the shales and schists with some attendant "grits" are of the Hudson River Group, and perhaps of the Utica Slate; and that the limestones and some quartzites are Cambrian or Silurian, that is, comprising strata either of the "Georgia" ["*Olenellus*"], Paradoxides, Potsdam, Calcareous, or Trenton.

It is certain that the three latter formations are largely represented. The fossils are unique and important, but they are in general altered, fragmentary, difficult to obtain and difficult to study.

A general sketch of the geology of this region is given in Notes 175 and 176 by Drs. Hunt and Dana, who represent diverse views on some of the important questions connected with the stratigraphy, and much information will be found in the tables and notes on stations in this region, especially in Notes 118, 119, 133, 163 and 173.

175. To the east of the Hudson River in New York we find besides the Laurentian rocks of the Highlands, a great development of the gneiss and mica-schists of the Montebello and of two other and very unlike series. The first of these is the Lower Taconic, consisting of the Stockbridge limestone with quartzites and peculiar slates. This series together with the Primary crystalline schists, stretches up northward, passing along the southeast side of the Highlands, and occupying portions of Eastern New York and Western New England. On the northwest side of the Highlands, extending northward along the valley of the Hudson, and as far as Lake Champlain, is found another series, variously designated as the Hudson River Group, the Taconic Slates or Upper Taconic series of Emmons, and the Quebec group of Logan. These rocks have been supposed to be Upper Cambrian or Silurian, (Utica, Lorraine and Oneida) but are now believed to be chiefly of Lower and Middle Cambrian ages. They are generally disturbed and often inverted, and include small outliers and involved portions of Upper Cambrian and occasionally of Silurian strata. This Upper Taconic or Cambrian group is distinct from and superior to the Lower Taconic. It is impossible in the present state of our knowledge of their distribution to define the limits of these various groups of strata to the east of the Hudson, or to say at what stations the Upper Taconic, the Lower Taconic (Taconian) or the Primary rocks are met with.

NOTE.—Dr. Hunt here uses the terms Cambrian, etc. as given in the first edition. See Note 2, also Dr. Hunt's table in the Introduction.

176. To the north of Putnam County, N. Y., whose rocks are with small exceptions Archean, there is a large development along the boundary between New York and New England of the "Lower Taconic Series" of Emmons, consisting of limestone, called in part the Stockbridge limestone, with hydromica and mica-schists and quartzite. These rocks

extend northward over a portion of Eastern New York and neighboring portion of Connecticut, Massachusetts and the southern half of Vermont. The limestones have afforded Lower Silurian fossils in Canaan, (see Note 173), Columbia County, New York and in West Rutland and elsewhere in Central Vermont. The rocks near Poughkeepsie were made part of the "Lower Taconic" and have recently afforded Lower Silurian and some Cambrian fossils. The slates were formerly all referred to the Hudson River Group. In Rensselaer Co., N. Y., occur slates and other rocks made "Upper Taconic" by Emmons, containing Cambrian fossils and similar rocks occur in parts of western and northern Vermont. J. D. DANA.

**Note on the Glacial Drift on Long Island
by Mr. Warren Upham, Assistant U. S. Geologist.**

177. On Long Island the terminal moraine of the continental ice-sheet extends from Fort Hamilton twenty-four miles in a nearly northeast course to Roslyn; thence it runs nearly due east sixty miles to Canoe Place and the Shinnecock Hills; next it turns northeast about eight miles to near Sag Harbor; and thence its course is east and east-northeast about twenty-five to Montauk Point. This range of hills long ago was called "The backbone of the island."

From the Narrows to Roslyn, this moraine varies from 100 to 250 feet in height, is mainly composed of unmodified drift, upper till on the surface, with glaciated pebbles and boulders in deep excavations. Its irregular contour is well seen in Greenwood Cemetery and Prospect Park and at Ridgewood Reservoir.

East of Roslyn it is almost wholly composed of modified drift, being waterworn gravel and sand with few or no boulders. These deposits are stratified, but often with oblique bedding and seem to constitute the entire mass of hills from 200 to nearly 400 feet high. Harbor Hill, a half mile east from Roslyn is the highest, 384 feet above sea, and is of this kind. In the same class are Jane's Hill, 354 feet; Rutland's, 340 feet; Osborn's or Bald Hill, a few miles southwest from Riverhead, 293 feet. The portion of this moraine forming the peninsula of Montauk, ten miles long and 150 to 200 feet high, is stratified, but contains frequent embedded boulders, which are also spread over the surface.

Long Island, south of this series of hills, consists of plains of fine gravel and sand 5 to 10 miles wide and 100 long. The north portion at the foot of the moraine is 50 to 150 feet above sea, from which height they slope southward. Numerous ancient water courses 10 to 25 feet deep and 100 to 300 feet wide cross from north to south. In some cases these channels continue beneath the sea level of the southern bays to the beach ridge, by which they are divided from the ocean.

A later terminal moraine 100 to 200 feet high, formed during a halt in the final retreat of the ice-sheet, of modified drift, except near Greenport and Orient, forms the north shore from Port Jefferson to Orient Point. It is separated from the extreme moraine by plains, also crossed by old channels of drainage.

Glacial Notes,

By PROF. T. C. CHAMBERLIN,

Of the United States Geological Survey and State Geologist of Wisconsin.

178. Roches Moutonnees at New York and for several stations east on the N. Y. & N. R. R.
179. Champlain.
180. Striæ.
181. Between Syracuse and Rochester drumlins have very fine development.
182. Between Victor and Fisher's, kame-like, semi-morainic hills are well developed.
183. Kame-like, semi-morainic hills.
184. Kame-like gravel hills.
185. Glacial flood deposits.
186. Gravel hills and terraces.
187. Moraine.
188. Valley drift, kame-like knolls.
189. Sub-aqueous drift.
190. Valley drift.
191. Moraine and glacial flood gravels.
192. Moraine and sub-aqueous drift.
193. Moraine(?) hills.
194. Sub-aqueous till; striæ.
195. Moraine(?) knolls.
196. Moraine glacial flood gravels.
197. Sub-aqueous till.
198. Kame-like knolls.
199. Kame-like knolls; Moraine(?).
200. Valley drift; Kame-like knolls; Moraines(?).
201. Kame-like and morainic hills.
202. Valley drift; moraine.
203. Moraine knolls.
204. Moraine kame-like hills.
205. Kame-like knolls and glacial flood gravels; moraine(?).
206. Valley drift; gravel knolls.
207. Striæ; moraine(?) in vicinity.
208. Valley drift; gravel knolls; moraine(?).
209. Moraine; gravel knoll.
210. Glacial flood gravels.
211. Moraine terrace.

New Jersey.

BY PROFESSOR JNO. C. SMOCK, ASSISTANT STATE GEOLOGIST, NEW BRUNSWICK, N. J.

Geological Formations or Epochs found in New Jersey.

20. Quaternary and Recent	{ 20 b. Champlain. 20 a. Glacial Drift.	Upper Silurian.	
Tertiary.		7. L. Helderberg	Upper Pentamerus Limest.
19. Tertiary.	19 c. Pliocene.	"	Encrinal
"	19 b. Miocene.	"	Delthyris Shale
"	19 a. Eocene (Upper Marl in part).	"	Lower Pentamerus
Cretaceous.		"	Tentaculite
18. Cretaceous.	18 g. Upper Marl (in part).	6. Salina.	6. Water Lime.
"	18 f. Yellow Sand.	Lower Silurian.	
"	18 e. Middle Marl.	5. Niagara.	5 a. { Medina Sandstone. Oneida Conglomerate
"	18 d. Red Sand.	4. Hudson.	4 c. Hudson River Slate.
"	18 c. Lower Marl.	"	4 b. Utica Slate.
"	18 b. Clay Marls.	4. Trenton.	4 a. Trenton Limestone.
"	18 a. Raritan Clays or Plas- tic Clays.	3. Canadian.	3 a. Magnesian Limestone.
16. Triassic, or New Red Sandstone.		2. Primordial or Cambrian.	2 b. Potsdam Sandstone.
Devonian.		1. Archæan.	1 b. Huronian.
	Green Pond Mountain Rocks.	"	1 a. Laurentian.
10. Hamilton.	10 a. Marcellus Shale.		
9. Upper Hel- derberg or Corniferous	{ 9 d. Corniferous. 9 c. Onondaga. 9 a. Cauda Galli.		
8. Oriskany.	8. Oriskany Sandstone.		

NOTES ON THE TABLE OF FORMATIONS.—No. 21, RECENT, includes the tidal meadows, the alluvial, upland necks of the southern part of the State, the sand-beaches of the Atlantic coast, and some of the peat-deposits of the interior.

Under 20 B., CHAMPLAIN, are placed the modified drift bordering some of the rivers; and deposits of the ancient lake basins.

No. 20 A., GLACIAL, represents the glacial drift north of the terminal moraine.

The YELLOW SAND AND GRAVEL of the southern part of the State is represented as PLIOCENE, 19 c.

The MIOCENE, 19 b., is identified by its characteristic fossils in Cumberland County, but it is not on any railroad line.

The EOCENE, 19 a., is recognized in the upper layers of the upper green-sand marl-bed.

The CRETACEOUS, 18, includes the green-sand marls of the southern part of the State and the plastic clays here designated as the Raritan clays.

Under 16, TRIASSIC, the trap-rock outcrops are included with the red sandstone.

The GREEN-POND MOUNTAIN series of shales, sandstones, and conglomerates are of Devonian age, but there is some uncertainty as to their true position. They are provisionally assigned to the Upper Devonian.

The MARCELLUS SHALE, the CORNIFEROUS and ONONDAGA LIMESTONES, the CAUDA GALLI GRIT, the ORISKANY SANDSTONE, the LOWER HELDERBERG SERIES, and the WATER LIME group occur in the Upper Delaware Valley, west of the Kittatinny Mountain. No railway line runs nearer to them than the New York, Lake Erie and Western Railway, at Carpenter's Point, and Port Jervis.

The 3 A. E. C., MAGNESIAN LIMESTONE, is the equivalent of the calciferous sandstone of New York.

The 4 B. E. C., UTICA SLATE, has not been outlined on any of the State maps, as it is almost impossible to separate it from the Hudson River slate.

In No. 1, ARCHÆAN, the subdivision is based on lithology alone. The gneissic, granitic, syenitic, and other associated crystalline rocks are assigned to the Laurentian, and the fine crystalline, hornblende, schistose rocks to the Huronian.

The reference to the newer and superficial formations is not made in all cases; and the more characteristic and typical localities only of the Recent and Quaternary ages are given.

Some of the stations are on the boundaries of formations and cover two outcrops. The aim is to give the most conspicuous and well-developed one in such localities.

Ms. | Northern Railroad of New Jersey.*			New York, Susquehanna, and Western Railroad—Con.		
0 Jersey City. ^{1 2}	1. Archæan, 16. Trias. ⁶		26 Midland Park.	16. Trias., 21. Recent. ^{2 25}	
7 New Durham. ³	{ 16. Triassic, 20. Quaternary, 21. Recent. ⁴		27 Wortendyke.	"	275
8 Granton.	"	4	28 Wyckoff.	"	345
10 Ridgefield.	"	5	30 Campgaw.	"	390
13 Leonia.	"	4	31 Crystal Lake. ¹¹	"	340
15 Englewood.	"	15	32 Oakland. ¹²	"	275
16 Highland.	"	55	35 Pompton. ¹³	{ 1 a. Laurentian, 20 b. Champlain.	220
17 Tenafly.	"	45	38 Butler.	"	360
18 Cresskill.	"	40	44 Charlotteb'gh. ¹⁴	"	725
20 Closter. ⁴	"	35	45 Newfo'ndland. ¹⁵	12. Catskill Devon.	770
22 Norwood.	"	40	47 Oak Ridge.	{ 4 c. Hudson River (?) 20. Quaternary. ²³⁰	
New York, West Shore, and Buffalo Railway.			51 Stockholm. ¹⁶	1 a. Laurentian.	960
Jersey City.	1. Archæan, 16. Trias. ¹⁰		53 Summit.	"	1032
Weehawken. ⁵	16. Triassic.	10	54 Two Bridges.	"	960
1 New Durh'm. ^{6 7}	{ 16. Trias., 20. Quaternary, 21. Recent. ⁴	4	57 Ogdensburgh. ¹⁷	{ 1 a. Laurentian, 20 a. Glacial.	660
5 Little Ferry.	"	4	60 Franklin. ¹⁸	{ 1 a. Laurentian, 2 b. Potsdam.	520
6 Ridgefield Park.	"	10	63 Hamburg.	3 a. Magnes. Limest.	455
7 Hackensack.	"	40	67 Deckertown.	4 c. Hudson River.	465
9 Teaneck.	"	80	71 Quarryville. ¹⁹	"	566
10 W. Englewood.	"	75	75 Unionville, N. Y.	"	520
12 Bergen Fields.	"	70	54 Two Bridges.	1 a. Laurentian.	960
12 Schraalenburgh.	"	90	57 S. Ogdensb'gh. ²⁰	{ 1 a. Laurentian, 20 a. Glacial.	515
16 Randall's.	"	60	61 Sparta.	3 a. Magnes. Limest.	660
17 West Norwood.	"	50	63 Sparta Junc. ²¹	{ 3 a. Mag. Limest., 20 b. Champlain.	580
19 Tappan, N. Y.	"	85	69 Washingt'nv. ²²	4 c. Hudson River.	
New York, Susquehanna, and Western Railroad.			72 Swartwood.	"	460
0 New York.	1. Archæan, 16. Trias. ¹⁰		76 Stillwater.	"	390
1 Jersey City.	16. Triassic.	4	80 Marksboro. ²³	"	360
7 Schuetzen Park.	16. Trias., 21. Recent. ⁴	4	82 Paulina.	3 a. Magnesian.	360
7 New Durham. ³	"	4	83 Blairstown.	"	370
12 Little Ferry.	"	10	85 Kalarama.	"	320
12 Ridgefield Park.	"	5	89 Hainesburg.	"	310
14 Bogota.	"	10	91 Warrington.	{ 3 a. Magnesian, 20 b. Champlain.	305
14 Hackensack.	"	65	92 Columbia. ²⁴	5 a. On'da & Medina.	280
16 Maywood.	"	45	96 Dunnfield. ²⁵	5 a. Medina.	325
17 Rochelle Park.	"	40	98 Dela. Wat. Gap.		
19 Dundee Lake.	"	100			
21 Paterson. ⁹	"	125			
24 Van Winkle's. ¹⁰	"				

* The altitudes are from the topographical sheets of "Atlas of New Jersey," prepared by the Geological Survey of New Jersey, Professor George H. Cook, State Geologist, and compiled by C. C. Vermeule, C. E., topographer.

1. The Archæan rocks are now all covered by improvements, and there are no outcrops; but a large part of the city has this formation as its underlying rock.

2. The Palisade range of Bergen Hill trap-rock in the western part of the cut, as seen at the tunnel.

3. The trap-rock of the Palisade range is seen on the east side, the whole length of this road to the New York line. (See Note 5, under New York.) On the left are the recent formations of the Hackensack meadows.

4. The sandstone lying upon the trap-rock can be seen on the mountain southeast of the station and near its crest.

5. At the east entrance to the tunnel the indurated shale, and above it the trap-rock, can be seen. One mile to the south there are good exposures of the latter rock cutting across the sandstone and shaly rocks. And sandstone was met with in the tunnel-cutting.

6. The sandstone on the west of the trap-rock is beautifully exposed in the west entrance to the tunnel. There are good sections showing glacial drift also.

7. The recent formations of the meadows along the Hackensack are seen on the left or west side from here to Hackensack.

8. (See Notes 3 and 6.)

9. The Garret Rock ridge of trap-rock is prominent in the southwest and south of the city. Passaic Falls, where the Passaic River falls seventy feet over ledges and through fissures of trap-rock.

Ms. | Green Pond Mine Railroad.			Ms. | Newark and Paterson Railroad.		
0	Charlotteburgh.	1 a. Laurentian.	725	New York.	
5	Green P'd Mines	"	940	1 Jersey City.	1. Arch., 16. Trias.
New York, Lake Erie, and Western Railroad.				9 Newark.	16. Triassic.
New York.				11 Belleville.	"
1 Jersey City.	1. Archæan, 16. Trias.	6		12 Avondale. ²⁹	"
6 Secaucus. ²⁶	16. Trias., 21. Recent.	5		13 Franklin.	"
9 Rutherford.	"	55		16 Peru.	"
12 Passaic.	"	55		17 Athenia.	"
14 Clifton.	"	60		20 Paterson.	"
15 Lakeview.	"	100	New Jersey and New York Railroad.		
17 Paterson. ²⁷	" 20 b. Champ.	77	1 Carlstadt. ³⁰	16. Trias., 21. Recent.	5
22 Ridgewood.	"	137	2 Woodridge.	"	15
24 Hobokus. ²⁸	"	197	6 Hackensack.	"	10
26 Allendale.	"	230	7 Cherryville.	"	10
28 Ramsey's.	"	345	9 New Milford.	"	10
30 Mahwah.	"	275	10 Oradell.	"	10
10 Rutherford Jn.	"	140	13 Westwood.	"	75
13 Garfield.	"	60	14 Hillsdale.	"	65
20 Ridgewood Jn.	"	110	15 Pascack.	"	115
			16 Park Ridge.	"	155

In Morris Hill, near the falls, fine section of sandstone and conglomerate, bedded trap-rock capped by the columnar trap.

10. Columnar trap-rock seen on west of road in the second mountain range.

11. Morainic drift surface is noticeable on north of road, from here to Oakland, where the modified or terrace drift can be seen, thence to Pompton on the left side of car.

12. Here the train approaches the gneissic rocks (1 a. Laurentian) in the eastern face of the Highlands.

13. South of Pompton Junction $\frac{1}{2}$ mile, and in the left bank of the Pequannock River, there is an isolated outcrop of black, slaty rock, which is probably Huronian. The locality is in sight from the railroad track. Graphite mine $\frac{1}{2}$ mile south of Bloomingdale, a flag-station between Pompton and Butler. From Pompton to Charlotteburgh the road follows the Pequannock River, and excellent views of the Highland ranges are to be had from the car-window.

14. The bold escarpment of the Copperas Mountain here comes in view, and west of this station the road passes through a gap in the range. It belongs to the Green-Pond Mountain series of Devonian age.

15. Green Pond Mountain is seen to the southwest of the station. Green Pond, a beautiful, natural lake, 1,048 feet high, is three miles south of Newfoundland.

16. East of Stockholm the line re-enters the outcrop of the Laurentian rocks, and runs thence over them to Franklin Furnace.

17. The railroad line here runs on a remarkable moraine, which, excepting the narrow passage for the Wallkill, stretches across the valley and is one hundred or more feet high, affording pretty views on each side. West of the station there are cuts in the white, crystalline limestone. The Sterling Hill zinc-mines are southwest of the station.

18. The noted Mine Hill is northeast of and in sight from the station. The zinc-mines of *Franklinite* ore are here. Famous mineral locality. The Potsdam sandstone is cut a few rods northwest of the depot.

19. The extensive meadows of the Drowned Lands are on the east of the road. Quarries of flag-stone on Flagstone Hill west of the station.

20. The valley of the Wallkill River is on the west.

21. Modified drift of Germany Flats conceals the limestone.

22. The road here runs near the line between the slate and the magnesian limestone of the Paulinskill Valley. The ridge bordering the valley on the southeast from Washingtonville to the Delaware River is slate.

23. Near Marksboro, White Pond is noted for its shell marl deposits of *Recent* age.

24. The station is on the river terrace. Northward two miles, the road enters the slate belt. Quarries of roofing-slate a little way east of the road.

25. The railroad line follows the river through the gap in the conglomerate of the main southeast ridge, and then across the Medina red, gray, and olive-colored shales and sandstones. Grand scenery.

26. The road here crosses a low, upland strip of sandstone. To the southwest are to be seen the Snake Hill and Little Snake Hill—trap-rock hills. The meadows to the southeast and to the northwest are *Recent*.

27. (See Note 9.) The modified drift is beautifully exposed in hills east of the depot and in the city.

28. The red sandstone is cut down deeply by the gorge east of the road. Northward to the State line the rock is covered by drift, and several side-cuttings show this drift.

29. The Belleville quarries, southeast of the station, yield annually a great amount of very excellent brownstone.

30. Tidal meadows to right. Sandstone ridge on left. The line follows the Hackensack and then the Pascack Rivers. Very few exposures of the rock; drift surface generally.

31. This railway west of the Erie line runs westerly, and cuts into the sandstone at the south side of Snake Hill, which is trap-rock mainly. West of Arlington it cuts deeply across the sandstone ridge.

New York and Greenwood Lake Railroad.			Delaware, Lackawanna, and Western Railroad— <i>Con.</i>		
Ms.			Ms.	Morris and Essex Division.	
0 New York.			20 Short Hills. ⁴²	{ 16. Triassic, 20 a. Glacial. 210	
1 Jersey City.	1. Archaean, 16. Trias. ⁶	120	21 Summit.	{ " " 381	
7 Arlington. ³¹	16. Triassic.	60	24 Chatham.	{ " " 232	
8 Newark.	"	140	27 Madison.	{ " " 245	
11 Bloomfield.	"	280	29 Convent. ⁴³	{ " " 385	
13 Montclair. ³²	"	360	31 Morristown.	{ 1 a. Laurentian; 16. Triassic. 326	
16 Montclair H'ghts	"	305	33 Morris Plains. ⁴⁴	{ 16. Triassic; 20 b. Champlain. 405	
17 Great Notch. ³³	16. Trias., 20 a. Glac.	250	37 Denville.	{ 1 a. Laurentian. 523	
18 Cedar Grove.	16. Triassic.	200	39 Rockaway.	{ " " 557	
19 Little Falls. ³⁴	{ 16. Triassic, 20 b. Champlain. 170		43 Dover. ⁴⁵	{ " 20 a. Glacial. 575	
20 Singac.	"	185	48 Drakesville.	{ 1 a. Laurentian. 797	
22 Mount'n View. ³⁵	"	180	52 Stanhope.	{ " " 873	
24 Pequannock.	"	190	56 Waterloo. ⁴⁶	{ " " 717	
26 Pompton Plains.	"	225	61 Hackettstown. ⁴⁷	{ 3 a. Mag. Limestone. 567	
27 Pompton.	{ 1 a. Laurentian, 20 b. Champlain. 255		67 Port Murray.	{ 4 c. Hudson River. 600	
32 Midvale. ³⁶	"	280	71 Washington. ⁴⁸	{ 1 a. Laurentian; 2 b. Potsdam. 600	
34 Ringwood Junc.	1 a. Laurentian.	340	76 Broadway.	{ 1 a. Laurentian. 380	
36 Ringwood. ³⁷	"	480	80 Stewartville.	{ 3 a. Magnesian. 360	
38 Hewitt.	"	621	84 Phillipsburg. ⁵⁰	{ " 220	
41 Cooper. ³⁸	"				
Surface of Greenwood Lake.					
44 State Line.	"	630			
Orange Branch.			2 Newark and Bloomfield Branch R. R.		
11 Watsessing Jn.	16. Triassic.	145	Newark.	16. Triassic.	38
14 Orange. ³⁹	"	160	4 Bloomfield.	"	115
			5 Montclair.	"	260
Delaware, Lackawanna, and Western Railroad.			3 Passaic and Delaware R. R.		
Morris and Essex Division.			Summit.	16. Triassic.	381
0 New York.			2 N. Providence. ⁵¹	"	220
1 Hoboken. ⁴⁰	16. Triassic.	35	5 Berkel'y H'ghts.	"	215
9 Newark.	"	185	8 Sterling.	"	220
12 Orange. ⁴¹	"	140	10 Millington.	"	280
15 South Orange.	"	147	12 Lyons.	"	315
19 Milburn.	"		15 Bernardsville. ⁵²	"	360

A slight fault is seen in this cut. The historic Schuyler mine (copper) is one mile northeast of this station.

32. The road here approaches the trap-rock range (First Mountain).

33. The railroad line crosses the First Mountain range part way through a gap. Good exposures of trap-rock in cuts. Going toward Cedar Grove, beautifully glaciated surfaces and good sections of glacial drift on the side of track.

34. Falls of Passaic River over trap-rock ledges in village northeast of station. Quarries in brown sandstone. Fine examples of trap-rock columns on shale one mile northeast of village and near the river.

35. The road here passes through a gap in the Towakow-Packanack range of trap-rock and enters the Pompton Plains basin, a part of the old glacial Lake Passaic. The southern portion is still wet, peaty meadow. Northward a gravelly plain. The Archaean highlands are seen on the left—or west side of the plains.

36. The isolated crests of gneissic ridges, nearly buried in the drift gravel, characterize this valley.

37. The long-worked and celebrated iron-mines of Cooper and Hewitt are here reached by this branch railway.

38. The largest lake in the State, lying between the Laurentian ridges on the east and the rough Bearfort and Bellvale Mountains on the west. The latter are of the Green-Pond Mountain series of rocks. At the south end and west side of the lake there are small outcrops of 4 c. *Hudson River*, 5a. *Oneida*, and *Medina*.

39. Famous basaltic columns at O'Rourke's quarry, west of the town.

40. At Castle Point, north of ferry, serpentine outcrops.

41. (See Note 39.)

42. Hills of glacial drift here are prominent; and the terminal moraine crosses the Second Mountain range south of Summit. Thence to Morristown the southern edge of the drift is, on the average, a half mile south of the railroad.

43. West of the station deep sink-holes appear near the line of road.

Ms. | 4 Chester Branch R. R.			Ms. | Central R. R. of New Jersey.		
Dover.	1 a. Laurentian.	676	0 New York.		
6 Succasunna. ⁵³	"	20 b.	1 Jersey City.	1. Arch'n; 16. Trias.	10
	Champlain.	705	4 Greenville.	16. Triassic.	20
8 Iroquoia	1 a. Laurentian; 20 b.		6 Bayonne.	"	20
	Champlain.	710	7 Bergen Point. ⁶⁴	"	15
13 Chester.	1 a. Laurentian; 20 b.		10 Elizabethport.	"	10
	Champlain.	685	12 Elizabeth.	"	20
5 Boonton Branch R. R.			15 Roselle.	"	70
0 New York.			17 Cranford.	"	65
1 Hoboken.	16. Triassic.	10	19 Westfield. ⁶⁵	"	130
4 Secaucus.	"	5	21 Fanwood.	" 20 a. Glac'l.	160
8 Kingsland.	"	40	24 Plainfield. ⁶⁶	"	105
9 Lyndhurst.	"	20	26 Dunellen.	"	60
12 Passaic.	"	70	31 Bound Brook.	"	36
16 Paterson. ⁵⁴	"	180	35 Somerville.	"	69
19 Little Falls.	"	185	36 Raritan.	"	75
22 M'tain View. ⁵⁶	"	185	40 North Branch.	"	92
24 Lincoln Park. ⁵⁷	"	170	45 White House. ⁶⁷	"	181
26 Whitehall. ⁵⁸	"	225	49 Lebanon. ⁶⁸	"	298
29 Montville. ⁵⁹	"	360	51 Annandale.	1. Archæan.	349
31 Boonton. ⁶⁰	1 a. Laurentian.	400	53 High Bridge. ⁶⁹	"	325
35 Denville.	"	522	56 Glen Gardner.	"	471
6 Warren R. R., or Main Line.—Con.			57 { Junction, Sum-		
66 Washington. ⁶¹	1 a. Laurentian; 2 b.		mit of N. J.	"	512
	Potsdam.	480	C. R. R.		
71 Oxford Furnace. ⁶²	3 a. Magnesian; 2 b.		61 Asbury. ⁷⁰	3 a. Magnesian.	438
	Potsdam.	492	63 Valley. ⁷¹	"	398
75 Bridgeville.	3 a. Magnesian.	395	65 Bloomsbury.	"	334
77 Manunka Chunk. ⁶³	4 c. Hudson.	320	68 Springtown.	"	312
80 Delaware	"	295	74 Phillipsburg. ⁷²	"	223
			2 Newark and New York R. R.		
			1 Jersey City.	1. Archæan.	10
			8 Newark.	16. Triassic.	25

44. The Archean rocks are west of the plains. The drift is thick and the plains are a part of the old glacial Lake Passaic. The road enters the Highlands north of this station.

45. Dover is the center of the iron-mine district of Morris County.

48. The Musconetcong Valley is here entered; the road passing through the terminal moraine a half mile north of Hackettstown.

47. The beautiful and fertile valley is here spread out before the traveler. Going south to Port Murray, deep cuts show slate. The Schooley's Mountain table-land is seen on the east.

48. The railroad cut exposes Potsdam sandstone and Laurentian gneiss. The Pohatcong Valley is here entered, and hence to Broadway the line follows at the side of the valley.

50. The railroad cut near Phillipsburg cuts a slaty rock, which may be Utica slate.

51. The railroad line runs down from Summit into the valley of the Passaic and along the south-east foot of Long Hill.

52. Bernardsville is at the border of the Laurentian Highlands.

58. Modified drift forms the surface of these plains.

54. The road runs close under Garret Rock. Quarries of sandstone on the east side of this mountain, where the trap-rock can be seen upon the sandstone. On the left side of the track there are side cuts in trap-rock and sandstone. On the right one sees the same rocks exposed in the bluff west of the mills. Fine view of the city is here also had.

56. (See Note 85.)

57. Here the road follows on northern foot of Hook Mountain and south of the Pompton Plains.

58. Between Whitehall and Montville there are very fine sections of high terrace hills at the right of the track. Footprints in red sandstone at quarry one mile southeast of the station.

59. Famous locality for serpentine and chrysolite at Gordon's quarry two miles north of this station. Fossil fish locality is about two miles southeast.

60. To the east and southeast the passenger looks over the red sandstone plain—to the distant Second Mountain range of trap-rock.

61. (See Note 48.)

62. Extensive iron-works and iron-mines. Tunnel through the gneissic rocks east of the station.

68. Tunnel in slate. Beautiful view of the Delaware and of Water Gap.

64. Railroad cut west of the station, near Newark Bay, shows old sand-dune upon sandstone drift.

65. Beyond this station, and on to Netherwood, railroad cuts show good sections of glacial drift where the terminal moraine is crossed.

66. The plain country southwest of the moraine is here reached. First Mountain (of trap-rock) is on the north.

Ms. | 3 Delaware and Bound Brook R. R.			Ms. | 7 Chester Branch R. R.		
0 New York.			64 German Valley.	3 b. Mag. limestone.	545
1 Jersey City.	1. Arch'n; 16. Trias.	10	70 Chester. ^{80 a}	1. Archæan.	845
31 Bound Brook.	16. Triassic.	36	Easton and Amboy R. R.		
35 Weston.	"		Lehigh Valley R. R.		
41 Van Aken.	"		0 New York.		
45 Skillman. ⁷³	"		1 Jersey City.	1. Arch'n; 16. Trias.	10
48 Hopewell.	"		26 Metuchen. ⁸¹	16. Trias.; 20 a. Glac.	100
53 Pennington.	"		33 Perth Amboy.	18 a. Raritan clays.	20
57 Ewing.	"		32 New Market.	16. Triassic.	52
61 Trenton.	1 Archæan.		36 Bound Brook.	"	39
4 South Branch R. R.			47 Neshanic.	"	113
0 New York.			54 Fleming't'n Junc.	"	116
1 Jersey City.	1. Arch'n; 16. Trias.	10	63 Clinton.	3 a. Mag. limestone.	200
35 Somerville.	16. Triassic.	69	61 Landsdown.	16. Triassic.	200
Roycefield.	"	109	64 Midvale.	"	350
Flaggtown.	"	135	66 Pattenburg. ⁸²	"	445
Neshanic.	"	94	69 West End.	1. Arch'n; 3 b. Mag.	450
Three Bridges.	"	114	71 Bloomsbury.	3 b. Magnesian.	395
52 Flemington.	"	195	75 Phillipsburg.	"	322
5 High Bridge Branch R. R.			Pennsylvania R. R.		
0 New York.			1. United Railroads of New Jersey.		
1 Jersey City.	1. Arch'n; 16. Trias.	10	New York.		
53 High Bridge.	"	335	1 Jersey City. ⁸³	1. Arch'n; 16. Trias.	10
58 Califon. ⁷⁴	2 b. Potsdam.	485	3 Marion.	16. Trias.; 20 a. Glac.	4
61 Middle Valley.	3 a. Mag. limestone.	505	4 Meadows. ⁸⁴	21. Recent; 16. Trias.	4
64 German Valley.	"	545	8 East Newark.	"	10
66 Naughtright.	"	575	9 Newark.	16. Triassic.	10
68 Bartley. ⁷⁵	{ 1. Archæan (?); 20 b.	630	11 Waverly.	"	10
70 Flanders.	Champlain.	687	14 Elizabeth.	"	29
75 Kenvil. ⁷⁶	"	727	17 Linden.	"	25
78 Port Oram.	1. Arch.; 20 a. Gla'l.	670	19 Rahway.	"	25
79 Dover. ⁷⁷	"	670	21 Houtenville.	"	35
83 Rockaway.	"	540	23 Iselin.	"	55
Hibernia Mine R. R.			24 Menlo Park. ⁸⁵	"	90
4 Hibernia. ⁷⁸	1. Arch.; 20 a. Gla'l.	540	26 Metuchen.	"	110
6 Ogden Mine R. R.			29 Stelton.	"	90
75 Kenvil.	{ 1. Archæan; 20 b.	727	31 N. Brunswick. ⁸⁶	"	50
80 Hopatcong. ⁷⁹	Champlain.	926	35 Adams.	"	110
Surface of lake	"	950	38 Deans.	"	83
83 Hurdtown. ⁸⁰	"	1226	41 Monmouth Junc- tion. ⁸⁷	{ 18 a. Cretaceous, Plastic clay.	92
90 Ogden Mines.	"		45 Plainsboro.	18 a. Cretaceous.	81
			47 Princeton Junc.	"	83
			50 Princeton.	16. Triassic.	220
			51 Lawrence.	{ 18 a. Cretaceous, Plastic clay.	90
			56 Trenton. ⁸⁸	{ 1. Archæan; 20 b. Champlain.	83

67. Round Valley Mountain to the southwest, a peculiar, horse-shoe shaped ridge of trap-rock. The railroad line is at north side of it.

68. About half a mile west of Lebanon the Archæan territory is entered.

69. Here the deep valley of the north branch of Raritan is crossed.

70. Limestone dipping under the gneiss of mountain is noticeable in the railroad cut northeast of the station. Hence to Bloomsbury the line runs near foot of the Musconetcong Mountain.

71. Large iron-mines one mile southwest.

72. (See Note 50.)

73. Sourland Mountain (trap-rock) appears on right side of the car, to northwest. Beyond the next station (Hopewell) the road cuts across the end of the Mount Rose or Rocky Hill range.

74. Here the road enters the German Valley, shut in by Archæan ranges of mountains.

75. The underlying formation (presumably Archæan) is here concealed by drift. The same is true at the succeeding stations of Drakeville and Kenvil. The low ridges on the east of the line are of sandstone (Green Pond Mountain series).

2 Woodbridge and Perth Amboy R. R.				Ms. | Lehigh and Hudson River R. R.			
Ms. |				0 Philadelphia.			
19 Rahway.	16. Triassic.	25		50 Phillipsburg.	3 a. Mag. limestone.	195	
20 Perth Amboy Jn.	"	20		64 Belvidere.	"	268	
22 Edgar's	{ 18 a. Cretaceous, Ra-			69 Buttsville.	"	391	
	ritan clays.	40		73 Townsbury. ¹⁰¹	"	500	
23 Woodbridge. ⁹⁹	18 a. Cretaceous.	15		75 Gt. Meadows. ¹⁰²	{ 20 b. Champlain.	528	
24 Spa Spring.	"	10		81 Allamuchy.	"	536	
26 Perth Amboy. ⁹⁰	"	40		83 Andover. ¹⁰³	"	590	
2 a. Belvidere Delaware R. R.				89 Sparta Junction.	"	580	
0 Trenton. ⁹¹	1. Arch'n; 2 b. Potsd. ³³	61		96 Franklin Junc.	"	520	
4 Asylum. ⁹²	16. Triassic.	64		98 Hamburg. ¹⁰⁴	{ 3 a. Mag. limestone.		
8 Somerset.	"	65			{ 20 a. Glacial.	460	
9 Wash'ton Cross.	"	67		108 McAfee. ¹⁰⁵	1. Archæan.	440	
10 Titusville. ⁹³	"	68		106 Vernon.	3 a. Mag. limestone.	410	
12 Moore's.	"	72		124 Greycourt, N.Y.			
16 Lambertville. ⁹⁴	"	82		Flemington Branch R. R.			
19 Stockton. ⁹⁵	"	95		16 Lambertville.	16. Triassic.	73	
23 Bull's Island.	"	96		19 Mt. Airy.	"	147	
26 Tumble.	"	125		23 Ringoes.	"	248	
31 Frenchtown.	"	127		26 Copper Hill.	"	153	
35 Milford. ⁹⁶	"	135		28 Flemington. ¹⁰⁶	"	182	
38 Holland.	"	163		3. Millstone Branch R. R.			
42 Riegelsville. ⁹⁸	3 b. Mag. limestone.	175		New York.			
45 Carp'terville. ⁹⁹	"	195		New Brunswick.	16. Triassic.	50	
50 Phillipsburg. ¹⁰⁰	"	220		33 Millstone Junc.	"	90	
53 Harmony.	"	231		34 Voorhees.	"	110	
57 Martin's Creek.	"	268		35 Clyde.	"	125	
64 Belvidere.	"	220		37 Middlebush.	"	115	
68 Manunka Chunk.	4 c. Hudson.			39 East Millstone.	"	55	

76. Northeast of Kenvil, about one mile, the terminal moraine is entered, and the railroad cuts afford good sections of the glacial drift, thence to Port Oram.

77. (See Note 45.)

78. Large mines of magnetic iron-ore, for which this road is the outlet.

79. Largest lake wholly in the State.

80. Iron-mines. Apatite locality. This railroad line has its terminus at large Ogden Mines.

80 a. Iron-mines in and near the village.

81. The terminal moraine is crossed by this road southeast of the station.

82. Here the road leaves the red sandstone territory and enters the gneiss in the Musconetcong tunnel. A fold of the magnesian limestone in it. At the west end entrance of the tunnel the deep cut exposes disintegrated gneisses, and to west the magnesian limestone and hydro-mica slates. West end iron-mines.

83. Bergen Cut, in trap-rock, between Jersey City and Marion.

84. The road here crosses the Newark Meadows. Much buried cedar timber in the black earth; and the stumps and fallen trunks may be seen from the car-windows.

85. The terminal moraine is crossed between this station and Metuchen.

86. The red sandstone forms bluffs in right bank of the Raritan, which are seen crossing the bridge.

87. Low cuts here and hence to Trenton in drift sand and gravel. They conceal the underlying formations.

88. The gneissic rocks are to be seen in the Delaware River above the railroad bridge. Northeast of the station a long cut exposes a gravel formation, which belongs to the Trenton terrace level. Mastodon tusk has been found in it. Rude flint implements found by Dr. Abbott in this formation, south of station, in the river bluff.

89. Center of fire-clay digging and fire-brick works. Very large banks west and south of the village.

90. Southern limit of glacial drift at mouth of the Raritan River.

91. A micaceous sandstone (Potsdam) near the Warren Street station.

92. Coarse, pebbly beds of the Triassic are noticeable near Asylum station. Thence, up the river, many cuts in the red sandstone. Near Greensburg there are large quarries of sandstone.

93. Trap-rock of Smith's Hill, north of Titusville.

94. Goat Hill (trap-rock) south of this station. North of it, and east of the town, remarkable examples of indurated shales. Tourmaline locality.

95. Sandstone quarries.

96. Flagstone quarries north and northeast of village. Pebble bluff, a huge wall of red conglomerate northwest of the village, at foot of which is the road. Nockamixon Cliffs on opposite (Pennsylvania) side.

98. Musconetcong Mountain range of gneiss south of station.

Ms. | 4. Rocky Hill Branch R. R.			6. Freehold and Jamesburg Agricultural R. R.		
	New York.				
41	Monmouth Junction.	{ 18 a. Cretaceous, Raritan clay. 92	41	Monmouth Junction.	{ 18. Cretaceous; a. Raritan clay. 92
45	Kingston.	16. Triassic. 60	48	Dayton.	" 90
47	Rocky Hill. ¹⁰⁷	" 60	49	Jamesburg.	" 73
5. Amboy Division.			54	Englishtown. ¹¹³	18. Cret.; a. b. Clay m'ls.
	New York.		58	Freehold.	{ " d. Red sand. ¹⁸⁸
	So. Amboy. ¹⁰⁸	{ 18. Cretaceous; a. Raritan clays. 20	61	Howell's.	{ " c. Lower marl.
8	Old Bridge.	" 10			{ " e. Middle marl.
10	Spotswood.	" 29	66	Farmingdale. ¹¹⁴	{ " f. Yellow sand.
14	Jamesburg.	" 73			{ " g. Upper marl.
16	Prospect Plains.	" 140	69	Allaire.	" Eocene.
18	Cranbury.	{ 18. Cretaceous; b. Clay marls. 110	78	Manasquan.	19. Tertiary.
21	Hightstown.	" 99	74	Sea Girt.	"
24	Windsor.	" 85	7. Pemberton and Hightstown R. R.		
27	Newtown.	" 122	0	Hightstown.	18. Cret's; b. Clay marls.
31	Yardville.	" 53	5	Sharon.	" "
34	Bordentown.	" 10	7	Imlaystown.	" "
37	Trenton. ¹⁰⁹	1. Archæan. 23	10	Cream Ridge. ¹¹⁵	{ " d. Red sand bed.
		{ 18. Cretaceous; a. Plastic clays; b. Clay marls. 10	12	Hornerstown.	" c. Lower marl bed.
35	White Hill. ¹¹⁰	" 10	15	New Egypt. ¹¹⁶	" e. Middle marl.
37	Kinkora.	" "	20	Wrightstown.	{ " f. Yellow sand.
39	Florence.	{ 18. Cretaceous; a. Plastic clays. 10			{ " g. Upper marl.
43	Burlington.	" "	23	Lewistown.	" f. Yellow sand.
46	Edgewater.	" "	25	Pemberton. ¹¹⁷	{ " e. Middle marl.
47	Beverly.	" "			{ " f. Yellow sand.
49	Delanco. ¹¹¹	" "			{ " g. Upper marl.
50	Riverside.	" "	9. Burlington R. R.		
53	Riverton.	" "			
54	Palmyra. ¹¹¹	" "	Burlington.	{ 18 Cretaceous; a. Plastic clay. 10	
57	Fish House. ¹¹²	" "			
61	Camden.	" "	Mount Holly. ¹¹³	{ 18. Cret'ous; b. Clay marl; c. Lower marl; d. Red sand.	
62	Philadelphia.	" "			

100. Two miles to north the railroad line runs at river foot of Marble Mountain. Hornblende schists, crystalline limestone, steatite (quarries) and gneisses. Some of these may be Huronian. River terraces at Belvidere.
101. The line skirts mountain on west, Pequest Valley on east. Terminal moraine lies across valley near Townsbury.
102. Great Meadows is an old glacial lake-basin filled by drift and recent alluvial deposits.
103. The once famous Andover iron-mine is northeast of station and near the track. To northeast a part of natural lake in modified drift, valley underlain by limestone.
104. A remarkable cut in glacial drift south of the station.
105. Large quarries in white, crystalline limestone in this vicinity and near Hamburg. On east the high Warramunda Mountains; on the west, Pochuck Mountain; both ranges of gneissic rocks.
106. Copper mine west of town.
107. Trap-rock quarries south of station.
108. Fossils of locality in clay-pits near shore.
109. (See Notes 88 and 91.)
110. Fine sections of clay-marls and the clays in the bluff, and at clay-banks near Kinkora. Northwest of Florence station and in the river bluff the yellow gravel covers thirty or more feet of Cretaceous clays and sands.
111. Fine section of gravel, sand, and Cretaceous clay in south bank of the Pensauken Creek.
112. Clay-pits. Locality of fossil unios in clay.
113. Marl-pits north of railroad line near Freehold. Red sand forms surface at Freehold.
114. Extensive marl-pits in vicinity. Lower layer of upper bed mostly opened. Upper layer is Eocene. Many fossils.
115. Lower marl is opened in this neighborhood for marls.
116. Good section along Greenwich Creek, showing all the marl-beds and their layers. Upper marl-bed is worked in vicinity of New Egypt. Many fossils.
117. Large pits near the village, in the middle bed.

8. Kinkora Branch R. R.			12. Medford Branch R. R.		
Ms. |			Ms. |		
0 Kinkora. ¹¹⁹	{	18. Cretaceous. a. Plastic clay.	0 Mount Holly.	{	18. Cret's; b. Clay marls. " c. Lower marl.
4 Columbus. ¹²⁰		b. Clay marls.	3 Lumberton.		" d. Red sand.
7 Jobstown.		18. Cret's b. Clay marl.	7 Medford. ¹²⁶		" d. Red sand.
9 Juliustown.		" c. Lower marl.			" e. Middle marl.
10 Lewistown.		" d. Red sand.			" f. Yellow sand.
		" e. Middle marl.			" g. Upper marl.
		" f. Yellow sand.			
10. Camden and Burlington County R. R.			New York and Long Branch R. R.		
0 Philadelphia.	{	18. Cret's; a. Plas. clay.	0 New York.	{	1. Arch'n; 16. Trias. ¹⁰
1 Camden.		" "	1 Jersey City.		16. Triassic. ¹⁰
6 Merchantville.		" b. Clay marl.	13 Elizabethport.		" "
11 Moorestown.		" "	14 Elizabeth.		" "
14 Hartford.		" "	21 Sewaren.		" "
15 Masonville.	{	" c. Lower marl.	25 Perth Amboy.	{	18. Cretaceous; a. Raritan clays. ³⁰
18 Hainesport.		" "	27 South Amboy.		" "
20 Mt. Holly. ¹²¹		" d. Red sand.	28 Morgan. ¹²⁷		" "
22 Smithville.		" d. Red sand.	30 Cliffwood.		18. Cret's; b. Clay marls.
24 Birmingham. ¹²²		" e. Middle marl.	32 Matawan. ¹²⁸		" "
25 Pemberton.		" "	34 Hazlet.		" "
			38 Middletown. ¹²⁹	{	" c. Lower marl.
			42 Red Bank.		" d. Red sand.
			44 Little Silver.		" "
			47 Branchport.		" d. Red sand.
			48 Long Branch. ¹³⁰		" e. Middle marl.
			50 Elberon.	{	" "
			52 Deal Beach. ¹³¹		" f. Yellow sand.
			55 Asbury Park. ¹³²		" g. Upper marl.
			Key East.		19. Tertiary; c. Pliocene.
			56 Ocean Beach.		" "
			58 Spring Lake.		" "
			60 Sea Girt.		" "
11. Pemberton and Sea-Shore R. R.			Freehold and New York R. R.		
25 So. Pemberton.	{	18. Cretac's; g. Upper marl; f. yellow sand.	0 New York.	{	1. Arch'n; 16. Trias. ¹⁰
29 New Lisbon.		19. Tertiary; c. Pliocene.	1 Jersey City.		18. Cret's; b. Clay marls.
43 Whitings.		" "	12 Matawan.		" "
52 Toms River.		" "	14 Keyport.		" "
55 Island Heights.		" "			
58 Barnegat Pier.	{	21. Recent. ¹⁰			
Seaside Park. ¹²³		" "			
60 Berkeley. ¹²⁴		" "			
64 Chadwick.		" "			
70 Bay Head.		" "			
Bay Head Junc.		" "			
71 Point Pleasant.		" "			
72 Brielle.		" "			
73 Manasquan.		" 125			
74 Sea Girt.		" "			

118. Holly Mount consists of red-sand bed capping lower marl rising above the clay-marl plain.

119. (See Note 110.)

120. Here, as at many localities in West Jersey, the strata are concealed; and the dip of beds is so slight that there is some uncertainty in some localities what are the underlying strata.

121. (See Note 118.)

122. (See Note 117.)

123. Sea-beaches (Recent).

124. Artesian well here strikes the marl-beds after penetrating overlying gravels, sands, and clays.

125. Or, possibly, Pliocene.

126. Marl-pits in both the middle and upper beds in the vicinity of village.

127. The railroad line here cuts into the stoneware clay-bed, going toward South Amboy. Southward the dark-colored clays and the clay-marls are exposed in the cuts.

128. Matawan Creek cuts into clay-marls.

129. Railroad cut through lower bed, at station. Deep cut in red sand south, one mile.

130. Surface clays and gravels may be Pliocene.

131. Pits in upper marl-bed—west of railroad line—at Poplar, also near Deal Beach.

132. The superficial beds are probably Pliocene. Artesian-well borings pass through these and reach the Cretaceous marl series.

133. Mount Pleasant Hills (red-sand bed and lower marl) to southeast.

134. Numerous marl-pits in vicinity, and many fossils. Red-sand bed forms hills generally.

135. A sandy strip of beach-sand and Recent.

136. Navesink Highlands to west of river—of red-sand bed, capping lower marl. Latter is seen in north or Raritan Bay side of Highlands.

148 AN AMERICAN GEOLOGICAL RAILWAY GUIDE. (NEW JERSEY.)

Ms. | Freehold and New York R. R.—Con.

Morganville. ¹³³	18. Cret's; b. Clay marls.
Wickatunk.	{ " c. Lower marl.
Marlboro'gh. ¹³⁴	" " d. Red sand.
22 Freehold.	" "

New Jersey Southern R. R.

New York.	21. Recent.
0 Sandy Hook. ¹³⁵	"
4 Highlands. ¹³⁶	"
6 Seabright.	"
8 Monmouth Be'ch.	"
10 E. Long Branch.	19. Tertiary.
11 Branchport.	18. Cretaceous.
13 Oceanport.	"
15 Eatontown.	{ " d. Red sand.
	" e. Middle marl.
18 Red Bank.	" "
17 Shrewsbury.	" " 54
15 Eatontown.	" "

Eatontown.	{ " f. Yellow sand.
21 Shark River. ¹³⁷	" g. Upper marl.
26 Farmingdale.	" "
26 Squankum.	" "
32 Lakewood.	19. Tert.; c. Pliocene. ⁵³
40 Manchester.	" " 45
45 Whittings.	" " 187
50 Wheatland. ¹³⁸	" " 143
53 Woodmansie.	" " 136
58 Shamong.	" " 98
69 Atsion.	" "
Atsion.	" "
78 Atco.	" "
78 Winslow Junc.	" "
79 Winslow. ¹³⁹	" "
84 Cedar Lake.	" "
89 Landisville.	" "
94 Vineland.	" "
97 Bradway.	" "
100 Rosenhayn.	" "
106 Bridgeton.	" "
108 Bowentown.	" "
118 Greenwich. ¹⁴⁰	21. Recent.
115 Bayside.	"

2. Atlantic Highlands Branch R. R.

0 Red Bank.	{ 18. Cret's; d. Red s'nd.
Chapel Hill.	" e. Middle marl.
6 Hopping.	" d. Red sand.
8 Atlantic Highlands.	" b. Clay marls.
	" d. Red sand.
6 Port Monmouth.	21. Recent; 18 a. Cl. mrl.

Ms. | 3. Toms River and Waretown R. R.

New York.	21. Recent.
0 Sandy Hook.	19. Tert'ry; c. Pliocene.
40 Manchester.	" "
47 Toms River.	" "
51 Bayville.	" "
53 Cedar Creek.	" "
55 Forked River.	" "
59 Waretown.	" "
62 Barnegat.	" "

Tuckerton R. R.

0 Whittings.	19. Tert'ry; c. Pliocene.
5 Bamber.	" "
7 Lacy.	" "
11 Middle Branch.	" "
15 Waretown Junc.	" "
17 Barnegat. ¹⁴¹	" "
21 Manahawken.	" "
26 West Creek.	" "
29 Tuckerton.	Recent.

Camden and Atlantic R. R.

0 Philadelphia.	18. Cret's; a. Plas. cl'ys. ⁶
1 Camden.	" b. Clay marls. ⁷⁸
7 Haddonfield.	{ " c. Lower marl.
10 Ashland.	" d. Red sand.
12 Kirkwood. ¹⁴²	" e. Middle marl. ⁶⁹
17 Berlin.	19. Tert.; c. Pliocene. ¹⁷⁶
19 Atco.	" "
23 Waterford.	" "
27 Winslow. ¹³⁹	" "
30 Hammonton.	" "
33 Da Costa.	" "
36 Elwood.	" "
41 Egg Harbor.	" "
47 Pomona.	" "
52 Absecon.	" and 21. Recent.
59 Atlantic City.	21. Recent. ⁸

Philadelphia, Marlton and Medford R. R.

0 Philadelphia.	18. Cret's; a. Plas. cl'ys. ⁶
1 Camden.	" b. Clay marls. ⁷⁸
7 Haddonfield.	" c. Lower marl.
13 Marlton.	" e. Middle marl.
	" "
18 Medford. ¹³⁶	{ " f. Yellow sand.
	" g. Upper marl.

Williamstown R. R.

0 Atco.	19. Tert'ry; c. Pliocene.
7 Williamstown.	" "

137. Much sandy gravel on hills in vicinity, which may be Pliocene. Shark River marl-pits near village and southeast of station. Noted Eocene fossil locality.

138. Clay-pits near station.

139. Glass-sand pits. Glass-works. Artesian well reached Cretaceous marls three hundred and sixty feet deep.

140. A very fertile alluvial upland neck.

141. The lower upland points are probably Recent, as are the tidal marshes along this coast.

142. Pits in middle marl-bed at side of track.

May's Landing and Egg Harbor R. R. Ms.		West Jersey R. R.—Con.	
Egg Harbor.	19. Tert'ry; c. Pliocene.	46 Manumuskinn.	19. Tert.; c. Pliocene.
May's Landing.	" "	53 Belleplain.	" "
		56 Woodbine.	" "
Philadelphia and Atlantic City R. R.		Sea Island City.	21. Recent, Sea-beach.
0 Camden.	18. Cret's; a. Plas. clays.	62 Seaville.	19. Tert'ry; c. Pliocene.
3 Oakland.	" "	69 Cape May, C. H.	" "
4 Linden.	" b. Clay marls.	Anglesea.	21. Recent, Sea-beach.
5 Dentsdale.	" "	75 Rio Grande.	19. Tert'ry; c. Pliocene.
7 Magnolia.	" "	78 Bennett.	" "
8 Somerville.	" c. Lower marl.	81 Cape May. ¹⁴⁷	21. Recent.
9 Laurel.	" d. Red sand.		
11 Clementon.	" e. Middle marl.	0 Camden.	18. Cret's; a. Plas. cl'ys. ⁶
14 Albion.	" g. Upper marl.	18 Glassboro.	19. Tert.; c. Pliocene. ¹⁴⁸
15 Lansborough.	19. Tert'ry; c. Pliocene.	20 Union.	" "
16 Willi'mst'wn Jn.	" "	24 Monroe.	" "
19 Cedar Brook.	" "	26 Elmer.	" " 112
21 Blue Anchor.	" "	29 Palatine.	" " 116
23 Winslow.	" "	31 Husted.	" " 96
27 Hammonton.	" "	38 Bridgeton. ¹⁴⁸	" " 51
30 Da Costa.	" "	0 Camden.	18. Cret's; a. Plas. cl'ys. ⁶
33 Elwood.	" "	26 Elmer.	19. Tert.; c. Pliocene. ¹¹⁹
38 Egg Harbor.	" "	31 Daretown.	" "
43 Pomona.	" "	34 Yorketown.	" "
49 Pleasantville.	" "	37 Riddleton.	" "
53 Atlantic City.	21. Recent.	38 Alloway.	" "
West Jersey R. R.		43 Salem.	{ " e. Middle marl. " 21. Recent.
0 Camden.	18. Cret's; a. Plas. cl'ys. ⁶	0 Camden.	18. Cret's; a. Plas. cl'ys. ⁶
30 Newfield.	19. Tert.; c. Pliocene. ¹¹⁴	8 Woodbury.	" b. Clay marls. ³⁴
33 Forest Grove.	" "	13 Clarksboro.	" "
36 Buena Vista.	" "	19 Swedesboro. ¹⁴⁹	{ " c. Lower marl. " d. Red sand.
47 May's Landing.	" " 10	26 Woodstown. ¹⁵⁰	" e. Mid. marl.
59 Pleasantville.	" "	30 Riddleton.	19. Tert'ry; c. Pliocene.
66 Somers Point.	" " 10		
64 Atlantic City.	21. Recent. ⁵		
Delaware River R. R.			
0 Camden.	18. Cret's; a. Plas. cl'ys. ⁶	0 Camden.	18. Cret's; a. Plas. cl'ys. ⁶
4 Gloucester.	" b. Clay marls. ¹⁶	8 Woodbury.	" b. Clay marls. ³⁴
5 Westville.	18. Cret's; b. Clay m'rls. ⁹	13 Paulsboro.	" "
8 Woodbury.	" " ³⁴	20 Bridgeport.	" "
11 Wenonah.	{ " d. Red sand. ³⁶ " e. Middle marl. ⁶³	24 Pedricktown.	21. Recent.
13 Barnsboro. ¹⁴³		28 Penn's Grove.	" "
18 Glassboro. ¹⁴⁴	19. Tert.; c. Pliocene. ¹⁴⁸		
21 Clayton.	" " ¹⁴³		
24 Franklinville.	" " ¹²³		
28 Malaga.	" " ¹⁰⁶		
30 Newfield.	" " ¹¹⁴		
34 Vineland. ¹⁴⁵	" " ¹¹⁰		
40 Millville. ¹⁴⁶	" " ³⁶		
Cumberland and Maurice River R. R.			
0 Bridgeton. ¹⁴⁸	19. Tert.; c. Pliocene. ⁵¹	0 Bridgeton. ¹⁴⁸	19. Tert.; c. Pliocene. ⁵¹
Fairton.	" "	Fairton.	" "
Newport.	" "	Newport.	" "
Dividing Creek.	" "	Dividing Creek.	" "
20 Port Morris.	" "	20 Port Morris.	" "

143. Large marl-pits, and branch railroad line to them.

144. Glass-sand pits between this place and Williamstown.

145. The gravel well exposed in railroad cut at station.

146. Glass-sand pits along Maurice River below the town.

147. On an upland island.

148. Glass-sand bed opened south of town in river-bank.

149. Lower marl-bed along Raccoon Creek.

150. Middle marl-bed here opened for marl digging.

This blank space is intended for additional geological notes in pencil by the traveler.

Pennsylvania.

By J. P. LESLEY, STATE GEOLOGIST.

LIST OF THE GEOLOGICAL FORMATIONS OF PENNSYLVANIA.

Prof. Dana's Table of the Formations.	Names Provisionally adopted in the Second Geological Survey of Pennsylvania, by Prof. J. P. Lesley.	Old Penn. Nos. of 1st Geo. Sur.
20. Quaternary.	20. Quaternary.	
16. Triassic.	16. Triassic.	
14 c. Upper Coal Measures.	14 c. { Green Co. Group.	XVII.
" "	" { Washington Co. Group.	XVI.
14 b. Lower Coal Measures.	" Monongahela River Series.	XV.
" "	14 b. Barren Measures.	XIV.
14 a. Millstone Grit.	" Allegheny River Series.	XIII.
13 b. Upper Sub-Carboniferous.	14 a. Pottsville Conglomerate.	XII.
13 a. Lower Sub-Carboniferous.	13 b. Mauch Chunk Red Shale.	XI.
12. Catskill.	13 a. Pocono Gray Sandstone.	X.
11 b. Chemung.	12. Catskill Red Sandstone.	IX.
11 a. Portage.	11 b. Chemung.	VIII f.
	11 a. Portage.	VIII e.
10. Hamilton, { Genesee.	10 c. Genesee.	VIII d.
	10 b. Hamilton.	VIII c.
	10 a. Marcellus.	VIII b.
9. Corniferous.	9. Upper Helderberg.	VIII a.
8. Oriskany.	8. Oriskany.	VII.
7. Lower Helderberg.	7. Lower Helderberg.	VI.
6. Salina.	6. Salina.	V c.
5 c. Niagara.	5 c. Niagara.	V b.
5 b. Clinton.	5 b. Clinton.	V a.
5 a. Medina.	5 a. Medina.	IV b.
	" Oneida.	IV a.
4 c. Hudson River.	4 c. Hudson River.	III b.
4 b. Utica.	4 b. Utica.	III a.
4 a. Trenton.	4 a. Trenton.	II b.
3. Canadian.	3 a. Calciferous.	II a.
2. Primordial or Cambrian.	2 b. Potsdam.	I.
1. Archean.	1. Azoic.	

NOTES ON THE TABLE OF FORMATIONS. All beneath the Potsdam is styled Azoic, because no survey has yet sufficiently differentiated the mass into its several systems. The term Eozoic is rejected, partly because both too vague and too shifting, and partly because it would suit the Cambrian system better than the Huronian and Laurentian, both of which remain to all intents and purposes Azoic. The terms Huronian and Laurentian are known to apply lithologically to rock masses in Pennsylvania, but their geographical relationships in the State are but imperfectly made out.

Much uncertainty still exists about the lines of demarcation between some of the formations in Pennsylvania, such as between the Catskill and Chemung; the Lower Helderberg and Clinton; the Hudson River and Utica; the Calciferous and Potsdam.

Niagara, Onondaga or Salina, Corniferous and other names were omitted, in the first edition, because of their uncertain presence in many districts of the State; and because of the narrowness of their upturned outcrops where they do exist.

Some of the places named in the following lists occupy positions covering the width of two or more steeply outcropping formations, to any one of which, therefore, they might be assigned.

In the northern and western counties it is often impossible to say precisely whether places stand upon Chemung, Catskill, Pocono or Mauch Chunk rocks. In such cases, Chemung has been preferred, because the others might be studied in the surrounding hills on account of the general horizontality of the bedding.

The last column in the table gives the numbers assigned to the Paleozoic formations in 1837, and their modifications since 1874. All above XII are additions.

J. P. L.

Pennsylvania.*

Pennsylvania Railroad.			Pennsylvania Railroad.		
Ms.	New York Division.	Alt.	Ms.	Pennsylvania Div.—Main Line—Con.	Alt.
0	W. Philadelphia.	1. Azoic.	53		
6	Kensington. ¹	20. Quaternary.	27		
18	Holmesburg.	"	61	Bird-in-Hand.	{ 2-4. Siluro-Cam- ³⁵⁹ brian Limestones.
23	Bristol.	"	69	Lancaster.	" ³⁵⁹
26	Tullytown.	"	76	Landisville. ⁵	" ⁴⁰⁵
82	Morrisville.	1. Azoic.	81	Mount Joy.	" ³⁸⁶
83	Trenton, N. J.	(See New Jersey.) ⁶³	87	Elizabethtown. ⁶	16. Triassic. ⁴⁵⁷
Pennsylvania Division—Main Line.			95	Branch Inter. ⁷	"
0	W. Philadelphia.	1. Azoic.	96	Middletown.	" ³¹⁴
5	Merion.	"	106	Harrisburg.	{ 4 a. Trenton Lime- stone and edge ³²⁰ of 4 b. Utica Slate.
9	Bryn Mawr.	"	111	Rockville. ⁸ ³⁵⁰	4 c. Hudson Riv. Slate.
20	Paoli.	"	118	Marysville.	5 a. Oneida Conglom'e.
22	Malvern.	"	120	Duncannon. ⁹	12 Catskill s. s. ³⁸⁶
28	Oakland. ² ³⁶⁶	{ 2-4. Siluro-Cam- brian. (Calcoif'ous?) 3 a. & 4 a. Magnesian Limesto's & Marbles	133	Newport.	11 b. Chemung. ³⁹⁵
33	Downingtown.	"	138	Millerstown. ¹⁰	{ 5 b. Clinton and ⁴⁰⁶ fossil iron ore beds.
39	Coatesville.	"	143	Thompsons town.	7. L. Helderberg. ⁴¹⁹
44	Parkersburg.	2 b. Potsdam s. s. ³³⁷	148	Tuscarora.	10. Hamilton. ⁴³⁹
47	Penningtonville.	"	152	Perryville. ¹¹	" ⁴⁴¹
51	Gap. ³	1. Azoic. ⁵⁵⁹	155	Mifflin.	5 b. Clinton. ⁴⁴¹
57	Lemon Place. ⁴	{ 2-4. Siluro-Cam- brian Limesto's. ³⁵²	162	Narrows. ¹²	"
			167	Lewistown.	7. L. Helderberg. ⁴⁹⁸
			178	McVeytown. ¹³	" ⁵²³

1. *Kensington*. This line runs along the Delaware river over alluvion and modified glacial drift, based upon Azoic rocks, upon which lie the bottom layers of the Cretaceous of New Jersey.

2. *Oakland*. Here the line finally leaves the Azoic rocks, across a fault, and passes white marble quarries to the Westchester Valley, rocks vertical, and probably identical with those of western Vermont.

3. *Gap*. Beds of quicksand. Wharton's famous nickel mine not far off.

4. *Lemon Place*. From here to Elizabethtown, over the garden of Pennsylvania, the great limestone plain of Lancaster; steep dips; plications and faults innumerable; structure difficult.

5. *Landisville*. Zinc mines recently worked one mile to the east.

6. *Elizabethtown*. Road runs for a mile or two along part of a greenstone trap dike, twenty miles long, extending from the Cornwall iron mines near Lebanon, to the Susquehanna river at Falmouth, and into the trap region of York County. Good place to study the action of the trap rock in metamorphosing the beds of New Red.

7. *Branch Inter*. South edge of the limestones of the Great Valley.

8. *Rockville*. Finest section in the State here. Seven miles thickness of rock, nearly vertical, slightly overturned, so that the upper formations seem to plunge beneath the lower, may here be measured, viz: From the Hudson River slates (Siluro-Cambrian), up to the Coal Measures on the summit of the Third Mountain.

9. *Duncannon*. Here a greenstone trap dike only 4 feet thick, crosses the road and river. It carries iron ore. One mile west, a coal bed is opened in the Pocono Sandstone, the representative of the New River Coal System of Montgomery County in Virginia. Five miles east is a curious notch in the summit of Peter's (Fourth) Mountain, where the Dauphin-Halifax Turnpike crosses its crest. The vertical wall is scored horizontally with *glacial striae* (?). Notice the terrace which the Catskill makes on the north flank of Peter's Mountain opposite Duncannon; it is the finest exhibition of Catskill terrace erosion in the State. See Notes 77 and 170.

10. *Millerstown*. Clinton fossil ore bed extensively worked here and at Mifflin.

11. *Perryville*. Best place to study the little coal beds in Hamilton (Lower Devonian) rocks.

12. *Narrows*. Long Narrows. River flows in a narrow synclinal between anticlinals of Medina.

13. *McVeytown*. Good place to study Oriskany glass sand quarries, one mile back of McVeytown on the opposite (north) side of river.

* The altitudes in this chapter are taken from Report N, by Charles Allen, Assistant Geologist, and from other reports of the survey. The datum is high water in the Schuylkill and seven feet have been added to reduce to mean surface of the Ocean.

Pennsylvania Railroad.			Pennsylvania Railroad.		
Ms.	Pennsylvania Div.—Main Line—Con.	Alt.	Ms.	Pennsylvania Div.—Main Line—Con.	Alt.
188	Newton Hamil'n.	599	308	Derry.	14 b. Barren Mres. ¹¹⁷³
191	Mount Union.	597	313	Latrobe. ²⁴ 1006	{ 14 c. Monongahela
195	Mapleton. ¹⁴	593			{ Riv. Series of C. M.
203	Huntingdon. ¹⁵	622	323	Greensburg.	" 1091
210	Petersburg.	678	328	Penn.	" 974
216	Spruce Creek. ¹⁶	777	333	Irwin's.	" 884
220	Birmingham. ¹⁷	866	343	Brinton's.	" 757
223	Tyrone.	907	347	Wilkinsburg.	14 b. Barren Mres. ⁹²³
227	Tipton. ⁴⁶	990	354	Pittsburgh. ²⁵	" 745
231	Bell's Mills. ¹⁸	1060	Philadelphia and Erie Division.		
237	Altoona.	1178	0	Sunbury. ²⁶	11 b. Chemung. ⁴⁴⁷
242	Kittanning Pt. ¹⁹	1594	2	Northumberland.	12 Catskill. ⁴⁵⁷
249	Gallitzin.	{ 14 b. Coal Meas. ³¹⁶¹	9	Montandon.	6. Salina. ⁴⁶⁴
		{ ures of the Alle-	13	Milton. ²⁷	" 476
		{ gheny Riv. Series.	17	Watson town.	" 482
252	Cresson.	" 2017	19	Dewart.	{ 10. Hamilton and 488
255	Lilly. ²⁰	" 1887	24	Montgomery.	{ 7. L. Helderberg. ⁴⁹¹
262	Wilmore.	" 1537	28	Muncy. ²⁸	5 b. Clinton. ⁵²⁰
265	South Fork. ²¹	" 1485	40	Williamsport. ²⁹	10. Hamilton. ⁵²⁸
269	Mineral Point.	" 1414	45	Linden.	11 a. Portage. ⁵³⁵
274	Conemaugh.	" 1225	52	Jersey Shore. ³⁰	11 b. Chemung. ⁵⁹⁵
276	Johnstown.	" 1184	57	Pine.	" 566
285	Ninevah.	" 1121	60	Wayne.	" 573
290	New Florence.	" 1076	65	Lock Haven. ³¹	" 559
295	Bolivar. ²²	" 1033			
301	Blairsville Int. ²³	" 1118			

14. *Mapleton.* Vertical Oriskany glass sand quarry on the opposite (east) bluff.

15. *Huntingdon.* Plenty of middle Devonian fossils to the south of the town, across the flat. One mile further on, high and picturesque pulpit rocks of Oriskany crown the bluffs on both sides of the river. Best view to be got by crossing the turnpike bridge at Huntingdon and riding a mile towards Petersburg. Fine pulpit rocks stud the crest of Warrior's ridge to the north and far to the north-east.

16. *Spruce Creek.* To the south are the Springfield Furnace mines. To the north-east, up Spruce Creek a dozen miles, are the largest limonite mines of the interior of the State.

17. *Birmingham.* Here Potsdam comes up in the center of the overturned anticlinal.

18. *Bell's Mills.* Blair's mine, between Bell's Mills and Altoona. An open quarry in limonite on Oriskany and Helderberg outcrops; very curious. Unique exposure of *celestine* in the bank of the creek below Bell's Mills.

19. *Kittanning Pt.* Horseshoe Bend, on 1° gradient, cuts off the point of a spur of horizontal Devonian measures, between two ravines; coal mines at the head of each ravine; curious scenery.

20. *Lilly.* Coal mines and coke ovens for miles.

21. *South Fork.* The anticlinal at the Viaduct brings up the Mauch Chunk Red Shale 20 feet above grade, and produces the three-mile loop in the river. A very curious place. Notice the boulders of false bedded Pocono sandstone lying in the bed of the valley below, under the viaduct.

22. *Bolivar.* A vast bed of fire-brick clay half a mile back.

23. *Blairsville Int.* Notice the arch of Pocono and Catskill opposite. On the opposite mountain top lies a small patch of the lowest coal bed of the Allegheny River series. See also note 73.

24. *Latrobe.* Here the Pittsburgh Coal Bed is first met—the lowest bed of the upper productive (Monongahela River) Coal Series. Down the Loyalhanna, left bank, six miles, the hill slope is covered with cubic blocks of sand rock 20 feet high and 100 feet on a side, moved several hundred feet down a gentle slope from their original sites.

25. *Pittsburgh.* The Pittsburgh Coal Bed is seen mined at the hill tops south of the city, 350 feet above the Monongahela River level. At the south end of the hill behind the city, stands an oil well derrick 70 feet high, 100 feet above the streets. It has been bored to a depth of 2,300 feet, through the Butler Oil Rocks, but yields nothing but a stream of strong brine.

26. *Sunbury.* Fine cliffs opposite, west side of the river. Superb landscape from hill $\frac{1}{4}$ mile back of station.

27. *Milton.* In the centre of a rolling plain of Salina anticlinals and synclinals crossing the river from east to west, bounded on the west by anticlinal Oneida and Medina Mountains called the "Buffalo," "Seven Mountain," "Jacks," etc., around the bases of which run the outcrops of the fossil ore.

28. *Muncy.* Plenty of fossils; fine cliffs of Chemung and Portage facing the river on the east side. Last appearance of Silurian Mountains of Middle Pennsylvania towards the north-east—the end of the Bald Eagle Mountain (5 a. Medina) close along the railroad. Facing the spectator, in the north, appears the wall of the Allegheny Mountain with patches of the lowest coal on the broken forest plateau above.

29. *Williamsport.* Five miles south, through a gap, lies the little secluded Musquito Valley of Siluro-Cambrian limestone, with black marble quarries of Trenton limestone.

Pennsylvania Railroad.			Pennsylvania Railroad.				
Ms.	Philadelphia and Erie Division—Con.	Alt.	Ms.	Philadelphia and Erie Division—Con.	Alt.		
69	Queen's Run. ³²	11 b. Chemung.	584	234	Pittsfield.	11 b. Chemung.	1241
75	Ferney.	"	595	238	Garland. ⁴³	"	1309
80	Whitham.	"	619	244	Spring Creek.	"	1395
86	Hyner.	"	644	249	Columbus.	"	1407
89	North Point.	"	657	251	Corry. ⁴⁴	"	1445
92	Renovo. ³³	"	672	256	Concord.	"	1384
98	Westport.	"	691	262	Union.	"	1270
102	Cook's Run.	"	709	269	Waterford.	"	1192
106	Keating.	"	719	275	Jackson.	"	1227
110	Round Island.	"	755	281	Belle Valley. ⁴⁵	11 a. Portage.	1006
117	Sinnemahoning.	"	794	288	Erie. ¹⁸⁹	"	555
120	Driftwood. ³⁴	12. Catskill.	815	Sunbury Branch.			
129	Sterling.	"	914				
133	Cameron. ³⁵	"	922	0	Sunbury. ³⁶	12. Catskill.	451
139	Emporium. ³⁶	"	1031	11	Danville. ⁴⁷	5 b. Clinton.	471
148	Beechwood.	"	1252	20	Catawissa.	Catskill—Chemung. ⁴⁷⁸	
160	St. Mary's. ¹⁶⁰⁷	{ 14 b. Allegheny Riv. Series of Coal Mres.	1478	54	Conyngham.	"	
165	Daguscahonda. ³⁷	12. Catskill.	1478		Cranberry.	14 b. Anth. Coal Mres.	
170	Ridgeway. ³⁸	11 b. Chemung.	1393		Hazleton. ⁴⁸	" " " 1325	
178	Wilmarth.	12. Catskill.	1447	36	Nescopeck. ⁴⁹	10 b. Hamilton.	
184	Wilcox. ³⁹	"	1526	58	Nanticoke. ⁵⁰	14 Coal Measures.	
189	Sergeant.	"	1716	63	Wilkesbarre. ¹⁸²	"	
193	Kane. ⁴⁰	14 a. Pottsville Conglo.		26	Mainville. ⁵¹	Pocono—Catskill.	597
199	Wetmore.	"	1808	35	Mt. Grove. ⁵²	13 b. Mauch Chunk.	
202	Ludlow.	"	1604	37	Rock Glen. ⁵³	Conglomerate.	939
209	Sheffield. ⁴¹	"	1339	39	Gowen.	14 Coal Mres.	1017
212	Tiona.	13 a. Pocono?	1362	43	Tomhicken.	"	1286
217	Stoneham.	12. Catskill.	1357				
222	Warren. ⁴²	11 b. Oil Sand Group.					
228	Irvinton.	"	1168				

30. *Jersey Shore*. Gap into secluded Nippenose or Oval Valley (anticlinal Trenton limestone, fossils) four miles south, and across the river in the gap stands a remarkable conical hill.

31. *Lock Haven*. Five miles south gap into Nippenose Valley; limestone; limonite mines; Trenton fossils, etc.

32. *Queen's Run*. Here the road enters the gate of the long gorge of the West Branch Susquehanna, and continues in it 61 miles to Driftwood; the floor of the gorge being sometimes Chemung and sometimes Catskill. Steep walls of Catskill and Pocono rocks, a thousand feet high, hem in the river, with its innumerable bends. Side gorges of the same nature open on both sides. On the hogback mountain tops between, covered with broken rocks and forest, lie patches of coal measures. The strata gently rise and fall in successive undulations, crossing the river at right angles. Old iron furnace of cut stone at Farrandville. Total failure to work sub-conglomerate carbonate iron ore. Similar failure in same ore at head of Tangascowtac Creek, opposite, to the west.

33. *Renovo*. Good hotel; machine shops of the company; coal mines on the top of the mountain, back of the town.

34. *Driftwood*. Low grade road to the great Jefferson county coal field, up Bennett's Branch.

35. *Cameron*. Coal mines on top of the mountain.

36. *Emporium*. Valley of erosion in Chemung rocks straight north into New York State. From here, the road (and river) rises fast, and reaches the general level of the upland at St. Mary's.

37. *Daguscahonda*. The lowest coal beds are mined all about here, and south of Daguscahonda. The road descends rapidly into the winding gorge or trench of the Clarion River to Ridgeway.

38. *Ridgeway*. Down the Clarion are coal mines and salt and oil borings (no oil).

39. *Wilcox*. Deep gas wells (no oil). The Bishop Summit coal mines, 10 miles to the northeast; Johnson's Run coal basin to the east.

40. *Kane*. Summit of the country. Lowest coal bed. Road northeast, through forest, 15 miles, to Alton coal mines; thence railroad down Tunliangwant to the Bradford oil wells.

41. *Sheffield*. Here the Olean conglomerate may be well studied in connection with the lowest coal bed.

42. *Warren*. Capital centre point for the geological student. Fossils in the hills around. Fine cliffs of Olean conglomerate crown the hill tops. Butler-Venango oil sands crop out in the foot-hills. Oil wells sunk in the valley bottom reach Warren oil sand group at 500 to 800 feet. Railroads down the river; and across to Titusville. Good hill-roads to Pleasantville and Oil City, along the great original oil belt.

43. *Garland*. Olean conglomerate quarries on the peak of the hill, one mile northwest. Top of oil sand crops out in the valley bed.

44. *Corry*. Oil refineries; very high land.

45. *Belle Valley* descends rapidly through a ravine, in Chemung and Portage rocks, to the lake shore.

Pennsylvania Railroad—Continued.			Pennsylvania Railroad—Continued.		
Ms.	Columbia Branch.	Alt.	Ms.	East Brandywine and Waynesboro.	Alt.
0	Lancaster.	{ 2-4. Siluro-Cambrian Limesto's. 259 " 404 " 251 " 260 " 271	0	Downingtown.	4 a. Trenton. 256
7	Mountville.		6	Brooklyn.	1. Azoi. 231
12	Columbia. ⁵⁴		12	Barneston.	" 236
16	Marietta.		18	Honeybrook.	"
23	Bainbridge. ⁵⁵		22	Beartown.	"
27	Falmouth.	16. Triassic.	28	New Holland.	"
30	Highspire.	" 200	Williamsburg Branch.		
38	Baldwin.	2-4. Siluro-Cambrian.	0	Williamsburg. ⁵⁸	4 a. Trenton. 247
37	Harrisburg.	4 b. Utica Slate. 220	6	Reese's.	10. Hamilton. 203
Pomeroy and Newark Railroad.			11	Frankstown. ⁵⁹	" 216
0	Pomeroy.	{ 2-4. Siluro-Cambrian. 483 1. Azoi. 274 " Serpentine. 282 " " Del. 16	14	Holidaysburg.	5 b. Clinton. 242
8	Newlin.		Ebensburg and Cresson Branch.		
6	Doe Run.		0	Cresson.	{ 14 b. Coal Mrs. 2022 Allegheny Riv. Ser.
12	Chatham.		6	Kaylor's.	" 2022
15	Avondale. ⁵⁶		11	Ebensburg.	" 2022
18	Landenberg.	Del. 16	Bedford Division.		
22	Thompson.		(See Huntingdon and Broad Top Railroad.)		
38	Delaware City.		0	Mount Dallas. ⁶⁰	5 b. Clinton. 1053
Frederick Division.			8	Bedford. ⁶¹	7. Lower Helderberg. 1062
0	Columbia. ⁵⁴	2-4. Siluro-Camb. 251	13	Napier.	5 b. Clinton. 1108
5	Stoner.	"	18	Sulphur Springs.	"
14	York. ⁵⁷	" 265	22	Bard's.	10. Hamilton.
19	Graybill.	" 426	31	Hyndman. ⁶²	7. Low. Held. 980
25	Minges Mill.	" 455	36	Cook's Mills.	" 774
32	Hanover.	" 599	39	State Line, Md.	" 728
39	Littlestown.	" 619	41	Mt. Savage, Jn."	" 687
47	Taneytown, Md.	" 498	45	Cumberland, "	" 638
70	Frederick, "	4. a. Trenton. 280			

46. *Tipton.* Branch railroad to mines recently opened in Pocono coal measures. Very important geological locality.

47. *Danville.* Famous and extensive fossil ore (Clinton) iron mines, sunk deep. Iron works here and at Bloomsburg. Ore crops along both sides of mountain ridge for 15 miles. May be studied on the anticlinal arch in the gaps at both places. Medina arch in the gap through Montour's Ridge. Fine cliffs of Portage and Chemung along the river. Fine collecting ground for fossils at the limestone quarries.

48. *Hasleton.* Mammoth and other anthracite beds mined extensively along this road; remarkable open out mines.

49. *Nescopee.* Fine gap through the Nescopee mountain to the south.

50. *Nanticoke.* A remarkable mining accident occurred in the vicinity of Nanticoke, December 18, 1885. The roof of a coal mine which was only three feet thick, but which was overlaid by 257 feet of glacial drift, caved in. The glacial gravel filled the mine and entrapped 28 miners. Exposure of red beds of No. XI, 500 feet thick on south side of river extending from Nanticoke gap to Shickshinny. The mountain on the north side of the river is made of No. X. No. XII caps the mountain on the south side of the river. The thickening of the red shale between Pittston and Nanticoke is gradual. See Note 122.

51. *Mainville.* Fine gap and section of Upper Devonian and Lower Carboniferous rocks here.

52. *Mt. Grove.* Pass the isolated synclinal McCauley's mountain and coal basin between here and next station.

53. *Rock Glen.* Enter here the northern basin of the Eastern Middle Anthracite coal field. Fine views down upon the red shale. Cunningham valley northward.

54. *Columbia.* Five miles back toward Lancaster, famous limonite iron mines. Road runs up the east bank of the river, six miles, under cliffs, to Chicques. Chicques rock, 800 feet high, Potsdam. Geology still obscure and very interesting.

55. *Bainbridge.* One mile after passing this, enter Trias (dipping N. W.) and continue on it to Highspire.

56. *Avondale.* Serpentine belt crossed here, and before reaching here.

57. *York.* This road follows the York county belt of the Cadorus (S. C.) limestones, with the south-east edge of the Trias, not far off on the right, and the north-west edge of the Azoi country on the left. Pigeon Hills (Azoi or perhaps Potsdam?) to the right before reaching Hanover. Trap dikes just west of Hanover, and at Littlestown.

58. *Williamsburg.* The great Springfield furnace limonite mines are (by Mine Railroad) five miles to the south.

59. *Frankstown.* Old and extensive Clinton (fossil) ore mines here.

Pennsylvania Railroad—Continued.			Pennsylvania Railroad—Continued.		
Ma.	Bald Eagle Valley Division.	Alt.	Ma.	Phillipsburg and Moshannon Branch.	Alt.
0	Tyrone.	907	0	Morrisdale.	14 b. Coal Measures.
5	Bald Eagle. ⁶⁰	1038	8	Osceola. ⁶⁷	" 1488
10	Hannah.	1057	18	Sterling.	"
14	Port Mathilde.	1007	17	Ramey.	"
21	Julian.	881	Holidaysburg and Morrison's Cove Branch.		
26	Unionville.	782	0	Altoona.	10. Hamilton.
29	Snow Shoe Junc.	722	4	Canaan.	"
81	Milesburg. ⁶⁴	700	8	Holidaysburg.	5 b. Clinton. 942
84	Curtin.	"	11	Reservoir.	" 967
40	Howard.	679	17	Roaring Spr's ⁶⁸	4 a. Trenton. 1198
44	Eagleville.	635	22	Martinsburg.	" 1366
51	Mill Hall.	573	28	Henrietta. ⁶⁹	" 1409
55	Lock Haven.	555	Southwest Pennsylvania Branch.		
81	Milesburg. ⁶⁴	700	0	Fairchance	14 c. U. Coal Mrs.
83	Bellefonte. ⁶⁵	744	2	Oliphant.	"
Tyrone and Clearfield Division.			7	Uniontown.	" 988
0	Tyrone.	907	11	Lamont Furn. ⁷⁰	" 1022
6	Vancoyoc.	1427	16	Dunbar. ⁷¹	" 995
18	Summit. ⁶⁶ 2042	14 a. Pottsville Conglo.	20	Connellsville. ⁷²	14 b. Barren Mrs. 915
19	Osceola. ⁶⁷	14 b. Coal Mrs. 1488	24	Pennville.	" 1054
24	Phillipsburg.	" 1425		Tarr's.	" 1099
29	Wallaceton.	" 1727	39	Youngwood.	" 957
84	Woodland.	" 1473	45	Greensburg.	14 c. U. Coal Mrs. 1091
41	Clearfield.	" 1103			
47	Curwinsville.	" 1141			

60. *Mt. Dallas*. Extensive fossil ore mines at Everett, east of Mount Dallas; and in the gap of the mountain approaching Bedford.

61. *Bedford*. Mineral waters. Abundance of Helderberg and Oriskany fossils; interesting and varied geology; iron mines around. Dunning mountain, fossil iron ore mines, north-east.

62. *Hyndman*. At north end of, but outside of the Cumberland coal basin.

63. *Bald Eagle*. This and the following stations are at old iron furnaces, not able to use their fossil ore close by, and therefore hauling Sil.-Cambrian limonites from the Warrior Mark Valley, over the Bald Eagle mountain.

64. *Milesburg*. Entrance gap to the Nittany Limestone Valley, which is full of iron ore banks.

65. *Bellefonte*. Trenton fossils abundant here. To the south-east, seven miles, Nittany Mountain, in the centre of the valley; fine views; curious geology; synclinal ships-keel mountain; turnpike road. Fine section of limestone beds on the great anticlinal of Nittany Valley.

66. *Summit*. Summit of Allegheny Mountain and east edge of the bituminous coal fields. Here Powell's semi-bituminous coal mines.

67. *Osceola*. Many coal mines along the Moshannon above and below this in the 1st sub-division of First Basin. Road gets into 2d sub-division over a low anticlinal. All the mines along this road are on beds of the Allegheny River series.

68. *Roaring Springs*. Here enter Morrison's Cove by a gap in the nearly vertical Medina and Oneida rocks of Dunning's Ridge. Fossil ore outside (W.); Bloomfield limonite mine (very famous) inside (E.). U. S. cannon made at Pittsburgh from pig metal from the furnace in the gap. Sinking springs up the run.

69. *Henrietta*. Old limonite mines (very rich), Schoenberger's. A few miles further on are the large, recent, and curious Leathercracker Cove limonite mines of the Cambria Company. Remarkable faults.

70. *Lamont Furnace*. Important outcrop of the iron ore beds underlying the Pittsburgh Coal bed.

71. *Dunbar*. Mauch Chunk red shale iron ore beds in the ravines of the mountain.

72. *Connellsville*. Centre of the coke trade. Miles of coke ovens along the road from here toward Greensburg and toward Mount Pleasant. (See Coke Report, L. 1877, Second Geological Survey of Pa.) Pittsburgh bed 12 feet thick in this narrow basin.

73. *Blairsville Int.* Occupies the same position on the Kiskaminitas that Connellsville (72) does on the Youghioghan, in the center of the narrow first gas coal basin west of Chestnut ridge. Pittsburgh coal bed on the hills opposite, south side river. See also Note 23.

74. *Saltburg*. Two miles further the Pittsburgh bed occupies the central hills of the third gas coal basin. Old salt wells along the river bringing up brine from the Pocono sandstone.

75. *Leechburg*. Famous gas well 1,250 feet deep, on south side of river. Gas from first (?) oil sand (of Butler and Venango) brought across the river on bridge, to rolling mill. Gas furnaces for puddling iron here first successfully used. See Report L. Geological Survey. Some miles to the south are the famous Murrysville gas wells.

76. *Tarentum*. Group of great gas wells; gas piped to Pittsburgh.

77. *Millersburg*. End of the long trap dike is just back of this. See Notes 9 and 170.

78. *Allegheny City*. Remark the typical Eddy Hill in the centre of plain, on which the Observatory stands.

Pennsylvania Railroad—Continued.			Pennsylvania Railroad—Continued.		
Ms.	Western Pennsylvania Division.	Alt.	Ms.	Lewisburg and Tyrone Railroad.	Alt.
0	Blairsville Int. ⁷³	14 b. L. Coal Mrs. ¹¹¹³	0	Montandon.	5 b. Clinton.
8	Livermore.	14 b. Barren Mrs. ⁹⁴⁵	2	Lewisburg.	" 463
17	Saltsburg. ⁷⁴	" 891	11	Mifflinburg.	" 868
24	Roaring Run.	" 830	19	Laurelton. ⁸³	" 607
32	Leechburg. ⁷⁵	14 b. L. Coal Mrs.	37	Coburn. ⁸³	4 a. Trenton. 1036
37	Allegheny Junc.	" 785	43	Rising Springs ⁸³	" "
88	Freeport.	" 772	57	Oak Hall. ⁸⁴	" "
45	Tarentum. ⁷⁶	" 757	58	Lemont.	" 1003
51	Springdale.	14 b. Barren Mrs. ⁷⁴⁹	Lewisburg and Tyrone Branch.		
57	Montrose.	" "	0	Scotia. ⁸⁵	3 a. Calciferous.
62	Sharpsburg. ¹⁰³	" " 739	9	Penn. Furnace. ⁸⁶	" 1074
67	Allegh'y City. ⁷⁸	" " 743	12	Marengo.	" "
0	Butler. ⁷⁹	14 b. L. Coal Mrs. ¹⁰⁰⁹	18	Warriors Mark.	" "
10	Delano.	" " 1283	21	Pennington.	" "
21	Butler Junction.	" " 768	25	L. & T. Junc. ⁸⁷	5 a. Oneida.
Lewistown Branch.			26	Tyrone.	5 b. Clinton.
1	Lewistown.	7. Lower Heldbrg. ⁴⁹⁹	Bellefonte and Snow Shoe Branch.		
6	Mann's. ⁸⁰	4 a. Trenton. 573	0	Bellefonte. ⁸⁸	4 a. Trenton. 744
13	Milroy.	4 and 3 a. Calcif. 746	3	Milesburg. ⁸⁴	10 a. Marcellus. 722
Indiana Branch.			4	Snow Shoe Int. ⁸⁸	" "
0	Blairsville Int. ⁸³	14 b. L. Coal Mrs. ¹¹¹³	6	School Hse. Cross.	12. Catskill.
8	Blairsville.	14 c. U. Coal Mrs. 1011	22	Snow Shoe City.	14 b. Low. Cl. Mrs. ¹⁵⁷³
18	Homer.	14 b. Barren Mrs.	Newry Branch.		
19	Indiana. ⁸¹	" 1211	0	Newry.	12. Catskill.
Lewistown Division.			2	Duncansville.	7. L. Helderberg. 990
0	Sunbury. ⁸⁶	12. Catskill. 444	8	Y Switches.	6. Salina.
5	Selinsgrove.	10. Hamilton. } of R. R. Allenton	4	Holidaysburg.	" 958
17	Middleburg.	5. b. Clinton. }	Springfield Branch.		
25	Beavertown.	" "	0	Springfield Junc.	4 c. Hudson Riv. 876
50	Lewiston.	7. L. Helderberg. 458	8	Mines. ⁸⁹	3 a. Calciferous. 1374

79. *Butler.* To get to the first productive deep oil wells one must go several miles north-east from Butler toward St. Jo., Petrolia, etc. The road descends to the Allegheny River over lower coal measures.

80. *Manns.* In the gap of Jack's Mountain is the spring and former residence of "Logan the Indian." Trenton rocks form cliffs. The Kishacoquillas Valley is shut in east of Milroy by two remarkable "ships keel" (synclinal) mountains of Medina and Oneida. The hull is Oneida, the keel Medina. The valley and its three arms are all surrounded by terraces of erosion. Taylor thought it was a terrace of deposit, and that the valley had been a lake. A turnpike drive across the valley from Logan's Gap, north-west, by the old iron mines, and over the Standing Stone mountain, to Greenwood furnace, with its fossil ore mines and fine scenery will repay. A fault cuts the mountain. The Clinton shales are curiously crumpled in the cuttings descending to the furnace.

81. *Indiana.* The barren coal measures cover most of Indiana County; underneath lie the Allegheny River coal series.

82. *Laurelton, Coburn.* Between Laurelton and Coburn the road gets through the Seven Mountains by following the deep transverse gorge of Penn Creek, crossing the anticlinals, which make the Buffalo Mountains in Union County; the last two being those of Poe Valley and Lick Valley. It issues at Coburn upon the wide limestone valley, full of sink holes and caves, with beds of limonite iron ore. Roundhead (synclinal) splits the east end. Brush Mountain forms the north wall.

83. *Rising Springs.* Egghill to the west, a synclinal knob of Medina left standing in the valley. Notice Long's cave at west end of Brush Mountain, at the opening of Brush Valley. Notice sink hole two miles west of Old Fort, which communicates, under Nittany Mountain, with the great spring one mile west of Pleasant Gap. Curious eddy hill in pleasant gap.

84. *Oak Hall.* Here Nittany Mountain ends, the Hudson River slates swinging round it. Oneida rocks on top; fine view toward Bellefonte, northward, and toward Tyrone, westward. Remarkable uncovered cavern, with more recent cavern under it along Big Hollow, four miles west. (See Report T. 4, p. 422.)

85. *Scotia.* Brown hematite (limonite) iron mines.

86. *Penn. Furnace.* The greatest old brown hematite mine in middle Pennsylvania. Excellent place to study the origin of such deposits. Other mines near the next three stations.

87. *L. and T. Junction.* In the Bald Eagle Gap.

88. *Snow Shoe Int.* Rocks all vertical. Oriskany outcrop continuous from here eastward to Lockhaven; none seen westward toward Tyrone.

Pennsylvania Railroad.—Continued.			Pennsylvania Railroad.—Continued.		
Ms.	Bloomfield Branch.	Alt.	Ms.	Columbia and Port Deposit Branch.	Alt.
0	Roaring Sprg. ⁸⁸	1196	0	Columbia. ⁸⁴	251
8	Orehill.		8	Washington.	223
	4 a. Trenton.		5	Creswell.	
	3 a. Calciferous.		11	Safe Harbor.	198
			14	Pequea.	
	Pittsburgh, Virginia and Charleston Ry.		10	McCall's Ferry ⁹⁶	169
	Now Monongahela Div. P. R. R.		24	Fishing Creek.	109
0	Pittsburgh. ²⁵	14 b. & c. Bar. Mrs. ⁷⁶⁶	27	Peachbottom.	4 c. Hudson Riv. ⁹⁹
15	McKeesport. ⁹⁰	" ⁷²⁷	32	Conowingo.	1 Azoic. ⁷¹
32	Mo'gahela City.	14 c. Upper Cl. Mrs. ⁷⁴⁸	35	Octoraro.	
55	Brownsville.	" ⁷⁶⁷	38	Rock Run.	
59	Tippecanoe.	14. Coal Measures. ⁸⁵⁴	40	Port Deposit, Md.	
63	Wolf Run.	" ⁸⁹⁵	44	Perryville.	21
65	Upp. Middletown	" ⁹¹¹			
70	Redstone Junc.	" ⁹³¹		Phila., Germantown & Chestnut Hill Branch.	
77	Uniontown.	" ⁹⁹⁰	0	Philadelphia.	1 Azoic. ⁸²
			12	Chestnut Hill. ⁹⁷	"
	Westchester Branch.			Northern Central Railway.	
0	Philadelphia.	1. Azoic. ⁸²	0	Baltimore, Md.	(See Maryland.)
24	Frazer. ⁹¹	" ⁴⁹⁰	47	Hanover Jun. ⁹⁸	2-4. Siluro-Camb. ⁴²²
26	Woodland.	" ⁵⁸¹	57	York.	" ⁸⁶⁶
28	Greene Hill.	"	67	Conewago. ⁹⁹	16. Triassic. ²⁸⁹
29	Fern Hill. ⁹²	"	73	Goldsboro. ¹⁰⁰	" ³⁰⁴
31	Westchester. ⁹³	" ⁴²⁰	79	Red Bank.	"
	Schuylkill Division.		84	Bridgeport. ¹⁰¹	4 a. Trenton. ³⁵⁵
0	Philadelphia.	1. Azoic. ⁶⁰	88	Harrisburg.	4 b. Utica. ³⁵⁰
4	Park.	" ¹⁶⁵	91	Marysville.	5 a. Oneida. ³⁵⁰
7	W. Laurel Hill.	" ¹⁵⁸	93	Dauphin. ⁹ ⁸⁴⁹	13 b. Mh. Ck. Red sh. ³⁶⁸
8	Manayunk. ¹⁸⁹	" ⁸⁹	99	Clark's Ferry.	12. Catskill. ³⁶⁸
9	Shawmont. ⁹⁴	" ¹⁰¹	106	Halifax.	12. Catskill. ³⁶⁸
13	Conshohock'n ¹⁴⁰	3 a. Calciferous. ⁶⁸	111	Millersburg. ⁷⁷	{ 13 b. Mauch Chunk ³⁶⁸
17	Norristown.	16. Trias. ⁸⁵			{ Red Shale. ³⁶⁸
28	Phoenixville. ¹⁴³	" ¹³¹	118	Mahantango.	12 Catskill. ⁴⁰⁴
40	Pottstown. ¹⁴⁴	" ¹⁴⁰	127	Trevorton. ¹⁰³	" ⁴³⁰
48	Birdsboro.	" ¹⁹³	133	Selinsgrove. ¹⁰⁴	{ 10. Hamilton & 7 ⁴³⁸
58	Reading. ¹⁴⁶	3 a. Calciferous. ²⁰⁹			{ Lewiston limestone. ⁴⁴⁴
			138	Sunbury. ³⁶	{ 12. Catskill or ⁴⁴⁴
					{ 11 b. Chemung.
					(Philadelphia and Erie to Williamsport.)

89. *Mines.* One of best and largest brown hematite iron mines in Pennsylvania on the sharp anticlinal axis of Canoe Valley, five miles east of Hollidaysburg.

90. *Port Perry, McKeesport.* Mines in the Pittsburgh coal bed line the river on both sides in a continuous series; the bed descending slowly from 360 feet above water level at Pittsburgh to within 30 or 40 feet in the neighborhood of Monongahela City. The bed rises again and goes into the air, ascending the Youghiogheny River; the banks becoming hillslopes of the Barren measures.

91. *Frazer.* From here to Fern Hill, study the belt of South Valley Hill talcose mica slate.

92. *Fern Hill.* Cross the serpentine belt.

93. *West Chester.* Supposed Laurentian gneiss belt.

94. *Shawmont.* Fine fresh rock cuttings of gneiss all along this part of the line; contortions; steatite quarry.

95. *Safe Harbor, Pequea.* Iron works.

96. *McCall's Ferry.* At Toquan Creek the great anticlinal crosses the river, which runs on north-eastward by Quarryville and Christiania into Chester County, north of the Chester Valley.

97. *Chestnut Hill.* The Valley of the Wissahiccon Creek on the west gives a fine section of the Chestnut Hill sub-division of the gneisses of the Philadelphia Azoic belt.

98. *Hanover Junc.* Magnetic and limonite iron ores from one to five miles west of this and in the ridges to the north and south.

99. *Conewago.* Cliffs of greenstone trap overhang the road and river.

100. *Goldsboro.* More trap cliffs from here to Red Bank. Magnetic iron ore bed above, back from the river.

101. *Bridgeport.* Fine long cuttings through Calciferous limestone opposite Harrisburg.

102. *Sharpsburg.* Iron works here were fired by natural gas brought in a pipe, 40 miles long, from the great gas wells in northern Butler County long before its introduction into general use in or near Pittsburgh.

Ms. Northern Central Railway.—Con. Alt.			N. Y., Lake Erie & Western R. R.—Con		
			Ms. Honesdale Branch. Alt.		
178 Williamsport. ²⁹	10. Hamilton.	840	0 Lackawaxen.	12. Catskill.	850
187 Cogan Valley.	12. Catskill.		4 Rowland's.	"	700
192 Trout Run. ¹⁰⁸	"	694	8 Millville.	"	780
198 Bodine's.	"		12 Kimble's.	"	849
202 Ralston.	14 b. Coal Meas.	860	16 Hawley.	"	899
203 McIntyre. ¹⁰⁶	"		20 White Mills.	"	925
207 Roaring Run.	12. Catskill.	940	25 Honesdale. ¹¹¹	"	966
212 Carpenter's.	11 b. Chemung.		Tioga Railroad.		
218 Canton.	"	1201	0 Corning.	(See C.C. & A.R.R.)	943
220 Minnequa Sprgs.	"	1261	15 Lawrenceville.	"	1006
222 Alba. ¹⁰⁷	12. Catskill.	1280	23 Tioga.	11 b. Chemung.	1042
231 Troy.	"	1249	31 Mansfield.	{ 11 b. Chemung	1140
236 Columbia X R'ds	11 b. Chemung.	1148	36 Covington.	{ Iron ore.	
241 Snediker's.	"	1148	41 Blossburg.	{ 11 b. Chemung.	1208
247 State Line.	"	1106	F. B. C. Co. R. R.		
256 Elmira, N. Y.	"	863	48 Fall Brook.	"	1242
Shamokin Division.			41 Blossburg.	"	1348
138 Sunbury. ²⁸	12. Catskill.	442	45 Morris Run.	"	1678
156 Shamokin. ¹⁰⁸	{ 14 b. Anthracite	738	41 Blossburg.	"	1348
164 Mt. Carmel. ¹⁰⁹	{ Coal Measures.	1054	45 Arnot.	"	1682
Summit Branch Railroad.			0 Elmira, N. Y.	11 b. Chemung.	868
0 Millersburg. ¹⁸⁶	{ 13 b. Mauch Chunk		10 State Line.	"	1092
8 Elizabethville.	{ Red Shale.	897	12 Millerton.	"	1246
14 Lykens. ¹¹⁰	"	677	15 Trowbridge.	"	1440
17 Dayton.	"		17 Summit.	"	1593
20 Williamstown.	"	1127	23 Tioga Junction.	"	1021
New York, Lake Erie & Western R. R.			Bradford Branch.		
Jefferson Branch.			0 Carrolton, N. Y.	(See Erie Railw'y)	1399
0 Susquehanna.	11 b. Chemung.	914	11 Bradford. ¹¹²	11 b. Chemung.	1444
11 Starrucca.	12. Catskill.		19 Big Shanty.	"	1666
14 Thompson's.	"	1703	26 Gilesville.	14 b. Coal Mres.	2055
25 Herrick Centre.	"	1803	14 Custer City.	Catskill & Chemung.	
33 Forest City.	13 a. Pocono.	1481	27 Kinzua B'dge ¹¹³	{ Carboniferous Con.	
38 Carbondale.	{ 14b. Anthracite	1079	32 Mt. Jewett.	{ and 13a. Pocono s.s.	
	{ Coal Measures.		42 Midmont.	14. Coal Measures.	
			53 Johnsonburgh.	13a. Pocono Sandstone.	

103. *Trevorton*. West end of the anthracite coal field. No anthracite west of this. Fine study of the lowest beds in the gap of the Conglomerate mountain.

104. *Sellinggrove*. Easternmost limit of the fossil ore outcrops of the Lewistown belt. Good anticlinal sections of 10. Genesee, Hamilton, Marcellus and 7. Lower Helderberg l. s. between here and Sunbury.

105. *Trout Run*. Entrance to the long gorge of the Lycoming Creek through the Allegheny Mountain plateau; similarly situated to Queens Run (32). Gorge exactly like that of the West Branch Susquehanna (32). Coal patches 1,000 feet above road level, up Trout Run.

106. *McIntyre*. Old iron mines under the cliffs of Pottsville conglomerate forming the cornice of the mountain walls. Great incline plain up mountain to McIntyre coal mines.

107. *Alba*. The Armenia Mountain of Catskill and Pocono dominates this on the west. On its top is the east end of the Blossburg-Antrim semi-bituminous coal basin.

108. *Shamokin*. In the gap opposite the town five ribs of Pottsville conglomerate enclose the four lowest anthracite coal beds. A cross section of the coal measures up to the 12th bed can be made here.

109. *Mt. Carmel*. In the center of the Shamokin group of three anthracite sub-basins.

110. *Lykens*. Here is a range of collieries on the southern outcrop of the famous Lykens Valley anthracite coal bed, which lies 50 or 100 feet above the Mauch Chunk red shale formation No. XI, and is, therefore, worked from the outside conglomerate wall of the Bear Creek coal basin. The bed seems to correspond to the famous block or iron furnace coal bed of Sharon in Mercer County, and of Nelsonville in Ohio. It is the lowest workable bed in the anthracite region.

N. Y., Lake Erie & Western R. R.—Con.			Delaware, Lackawanna & Western Railroad.		
Ms.	Toby Branch.	Alt.	Ms.		Alt.
0 Brockwayville.	14 b. Lower Coal Mrs.		0 New York.	(Cont. from N. Jersey.)	
4 Brockport.	"		84 Delaware.	4 c. Hudson River.	
6 Hellen Mills.	"		92 Water Gap. ¹¹⁶	5 a. Oneida.	319
10 Kyler's Corners.	"		96 Stroudsburg. ¹¹⁷	10. Hamilton.	403
12 Dagus Mines. ¹¹⁴	"		100 Spragueville.	Catskill-Chemung.	499
New York, Pennsylvania & Ohio R. R.			104 Henryville.	"	596
0 Salamanca.	(See New York.)	1393	109 Oakland.	12. Upp. Catskill.	1011
61 Corry. ⁴⁴	Oil Sand Group.	1431	115 Forks.	"	
72 Union City.	"	1301	122 Tobyhanna.	"	1932
79 Mill Village.	"	1216	128 Goldsboro. ¹¹⁸	"	
88 Cambridge.	"	1163	136 Moscow.	"	1558
92 Venango.	"	1163	139 Dunning's. ¹¹⁹	"	1400
96 Seagertown.	Sub-Conglomerate	1116	149 Scranton.	{ 14b. & c. Anthra-745	
102 Meadville.	"	1080	159 Abington.	cite Coal Measures.	
110 Geneva.	"	1069	164 Factoryville. ¹²⁰	12. Catskill.	1058
116 Evansburg.	14. Conglomerate.	1284	174 Nicholson.	"	920
121 Atlantic.	"		176 Foster.	Catskill-Chemung.	769
129 Greenville.	Sub-Conglomerate.	984	183 Montrose.	"	1053
131 Shenango.	"	936	190 New Milford.	"	1087
135 Transfer.	"	993	196 Great Bend.	11 b. Chemung.	879
(Continued in Ohio.)			210 Binghamton.	(Cont'd in N. Y.)	846
Franklin Branch.			Bloomsburg Division. ¹²¹		
0 Meadville.	Sub-Conglomerate	1089	0 Scranton.	{ 14 b. and c. Anth'e Coal Measures.	Over the Great Lackawanna and Wyoming coal basin.
6 Shaw's.	"	1092	6 Lackawanna.	"	
11 Cochranston.	"	1034	9 Pittston. ¹²⁴	"	
19 Utica.	"	1035	12 Wyoming.	"	
28 Franklin. ¹¹⁵	"	987	20 Plymouth.	"	
36 Oil City.	"	1006	24 Nanticoke. ⁵⁰	"	
			33 Shickshinny. ¹²²	14a. Pottsville Con.	520
			41 Beach Haven.	10 b. Hamilton.	530
			47 Briar Creek.	10. Hamilton.	501
			54 Espy. ¹²³	7. Low. Helderberg	490
			58 Rupert.	11 b. Chemung.	482
			68 Danville. ⁴⁷	5 b. Clinton.	457
			80 Northumberland.	12. Catskill.	452

111. *Honesdale*. Head of the Delaware and Hudson Canal supplied with Carbonate and Scranton anthracite coal of the third great basin by railroads coming out of the basin over the Wyoming mountains.

112. *Bradford*. Petroleum was first found in the Bradford (Chemung) black oil sand in 1871. The area of productive oil territory in the Bradford district up to January, 1885, was 121 square miles, and during 14 years had produced on an average 820,000 barrels of crude oil per square mile (C. A. Ashburner). The most productive oil region in the State, and, until the discovery of oil at Smethport and Kane, the lowest of the Pennsylvania oil horizons, 1,775 feet below the Olean conglomerate. (J. P. L.)

113. *Kinross Bridge*. Highest bridge structure in the world; 301 feet high, 2,052 feet long; contains 3,500,000 pounds iron; cost \$275,000.

114. *Dagus Mines*. Extensive workings in the Lower Kittanning coal bed by the New York, Lake Erie and Western R. R. Co.

115. *Franklin*. Lubricating oil from the first sand. At Stoneboro and Mercer, on the road to Newcastle, local glacial moraines are reported by Prof. T. C. Chamberlin of the U. S. Survey.

116. *Water Gap*. Celebrated for its scenery. Large hotels. Indian staircase in the gap made by massive north dipping outcrops of Medina and Oneida. One mile before reaching these rocks are quarries of Hudson River roofing slate on both sides of the Delaware River. Best headquarters for studying the great Terminal Glacial Moraine, which crosses the river at Belvedere and the mountain at Fox Gap, and runs past Lake Poponoming, northward, to the top of Penobscot Knob and so west by Long Pond to the Lehigh. See descriptions, pictures and maps in Report Z, Geological Survey.

117. *Stroudsburg*. Excellent geological headquarters. Fine exposures of Oriskany, Waterline, etc., etc., in the ravine of Broadhead's Creek between the gap and Stroudsburg. Fossils abundant around Stroudsburg. Buttermilk and other cascades to the right of the road (east). Noble carriage drive and exquisite scenery, for 30 miles from Stroudsburg to Milford. Lake on top of the Blue (Kittatinny) Mountain, 10 miles east of S. Fine drive south-west through Red Valley (Clinton) and over outcrops of Helderberg to the Wind Gap. Ascent of the Pocono Knob (Catskill) to the north-west.

Lehigh Valley Railroad.			Lehigh Valley Railroad.		
Ms.		Alt.	Ms.	Pa. & N. Y. R. R.—Continued.	Alt.
0	Perth Amboy.	(See New Jersey.)	244	Wysauking. ¹³⁵	11 b. Chemung. 715
61	Easton. ¹²⁵	3 a. Calciferous. 210	248	Towanda. ¹³⁶	" 737
73	Bethlehem. ¹²⁶	" 235	255	Ulster.	" 742
88	Allentown.	" 254	259	Milan.	"
81	Catasauqua. ¹²⁷	4 a. Trenton. 282	263	Athens.	" 779
87	Laury's.	4c. Hudson Riv. Sh. 329	265	Sayre.	" 774
94	Slatington. ¹²⁸	" 365	268	Waverly, N. Y.	" 830
103	Lehighton. ¹²⁹	11 b. Chemung. 465	Mahanoy, Hazelton & Beaver Meadow Branches.		
107	Mauch Chunk. ¹³⁰	13b. M'ch Ch'k r.s. 544			
114	Penn Haven.	" 705	0	Penn Haven Jc.	13b. M'ch Ch'k r. s. 705
120	Drake's Creek.	12. Catskill.	4	Black Creek Jc.	" 1015
130	Tannery.	"	5	Weatherly.	" 1090
132	Whitehaven.	13 b. Mauch Ch'k. 1143	11	Beaver Meadow.	14b. An. Cl. Mres. 1355
142	Summit Siding.	13 a. Pocono. 1728	15	Audenreid.	" 1733
146	Fair View. ¹³¹	" 1673	10	Lumber Yard.	"
152	Newport. ¹⁰²³	13b. M'ch Ch'k r.s. } Wyoming Valley	14	Jeddo.	"
		14 a. Potts. Cong. }	16	Ebervale.	"
158	Sugar Notch. ⁶⁶⁶	14b. An. Cl. Mres. }	16	Freeland.	Carbonif. Conglom.
162	Wilkesbarre. ¹³²	" 549	15	Hazelton. ⁴³	14 b. Anth. Cl. Mres.
168	Fort Blanchard.	"	23	Tomhicken.	"
	Pa. & N. Y. R. R.		18	Quakake Junct.	13 b. Mauch Ch'k. 1315
170	Pittston.	" 571	22	Delano.	14b. An. Cl. Mres. 1665
172	L. & B. Junction.	" 569	27	Mahanoy City.	" 1280
183	Falls. ¹³³	12. Catskill. 587	30	Shenandoah. ¹³⁷	"
186	McKunes. ¹³⁴	" 597	35	Girardville.	"
194	Tunkhannock.	" 610	38	Ashland.	" 856
199	Vosburg.	" 615	36	Raven Run.	"
206	Mehoopany.	" 634	40	Centralia.	" 1484
209	Meshoppen.	" 643	45	Mt. Carmel. ¹⁰⁹	" 1056
217	Laceyville.	Catskill-Chemung. 657	59	Shamokin. ¹⁰⁸	" 730
227	Wyalusing.	" 674			
233	Frenchtown.	11 b. Chemung. 689			
237	Rummerfield.	" 696			

118. *Goldsboro*. Head waters of Lehigh, on the extreme highland, "shades of death," "beach woods," a plate of Pocono rocks covered here and there by synclinal outcrops of Mauch Chunk red shale.

119. *Dunnings*. Commence descent into third anthracite coal field by a ravine through the Pottsville conglomerate. Under it the iron ore of XI has been opened.

120. *Factoryville*. Now over the Elk Mountain synclinal range of Pocono in the first bituminous coal basin; but no coal.

121. *Seranton to Pittston*. Terraces and drift hills along railroad, also glacial striae at Pittston and Taylorville.

122. *Shickshinny*. River cuts across the coal field, leaving a small ridge of coal measures isolated on the west side. Here all the measures from No. X to No. XIII, inclusive, can be seen from the station. The Susquehanna's course through the synclinal at right angles to its axis is interesting here. See Note 50.

123. *Kopy*. Square across to the north, six miles, is seen the high end of the Shickshinny (Pocono) Mountain, reached by a good road from Bloomsburg, seven miles, and affording one of the finest panoramic views in Pennsylvania. The glacial moraine crosses that mountain from Berwick northward.

124. *Pittston*. In the gap north of the station the red shale beds of No. XI are missing.

125. *Easton*. Famous collecting ground for rare minerals. Azoic ridge to the north, with serpentine belt. Remarkable outcrops, natural and artificial, of the calciferous limestones along the river north bank to Bethlehem. Many iron works. Laurentian rocks south of the river all the way up.

126. *Bethlehem*. Zinc works. Zinc mine in Saucon Valley to the south, easily reached by N. P. Railroad.

127. *Catasauqua*. Perhaps the best limonite open mine in America for study, lies four miles west (Ironston). Best reached on wheels; also by rail, over a long, high iron bridge. Manganese, kaolin, lignite, with the ore. Mine very large and old.

128. *Slatington*. Extensive roofing slate quarries here where the roofing slate belt from the Delaware river crosses the Lehigh river on its course west into Berks County. Note the duplication of the slate bands by anticlinals and synclinals, as described in Report D. 3, Vol. I, Geological Survey. Two miles further enter the Lehigh Water Gap between sloping walls of Oneida and Medina. Issue upon Clinton red shale. Notice a fine Eddy Hill opposite. Behind it is a local moraine, which a glacier, formerly descending the Lehigh, left across the mouth of the Aquashicola Creek, forcing that stream to excavate a new channel in the solid Medina rocks of the mountain. Two miles farther, at the bend of the river, north bank, the ice has crushed over the slates, polished the surface and loaded it with till. From the Gap Hotel ride to the top of Stone Hill (Oriskany outcrop) for the view through the Gap. Hydraulic lime quarries on the way up.

Ms.	Barclay Railroad.	Alt.	Ms.	Philadelphia and Reading R. R.	Alt.
0 Towanda. ¹³⁶	11 b. Chemung.	725	0 Philadelphia.	1. Azoic.	28
7 Greenwood.	12. Catskill.	823	4 Belmont.	"	49
16 Barclay. ¹³⁸	14 b. Coal Mres.	1756	8 W. Manay'k. ¹³⁹	"	61
State Line and Sullivan Railroad.			14 W. Consho'n. ¹⁴⁰	"	61
0 Towanda. ¹³⁶	11 b. Chemung.	725	17 Bridgeport. ¹⁴¹	8 a. Calciferous. ?	76
4 Monroeton.	"	763	22 Port Kennedy.	2 b. Potsdam.	87
24 Dushore.	12. Catskill.	1593	24 Valley Forge. ¹⁴²	"	98
29 Bernice.	{ 14 b. Loyalsock Coal Measures, semi- Anthracite.	1858	28 Phoenixville. ¹⁴³	16. Triassic.	110
			32 Royer's Ford.	"	127
			40 Pottstown. ¹⁴⁴	"	150
			45 Douglasville.	"	161
			47 Monocacy.	"	162
			52 Exeter. ¹⁴⁵	"	193
			58 Reading. ¹⁴⁶	8 a. Calciferous.	268
			66 Leesport.	4 b. Utica. ?	298
			70 Shoemakersville.	4c. Hud's'n Riv. s.l.	314
			75 Hamburg.	"	375
			78 Pt. Clinton. ¹⁴⁷	5 b. Clinton.	410
			88 Auburn. ¹⁴⁸	7. Low. Helderberg	471
			86 Landingville.	11 b. Chemung.	503
			93 Pottsville. ^{149 614}	14b. & c. An. Cl. Mres.	
			</		

129. *Lehigh*. On the crest of one of the grandest anticlinals in the State. The gently south dipping Chemung and Hamilton here turn over and descend vertically. From here to Mauch Chunk the vertical Devonian and Bernician systems are crossed at right angles, so as to give an easy section of 10,000 feet, up to the coal measures.

130. *Mauch Chunk*. Fine geological headquarters. The gap in the Second mountain gives the whole Pocono and Catskill. The river above gives the Mauch Chunk red shale. Mt. Pisgah the Pottsville conglomerate. Nine miles up the "passenger tourist's gravity road" lies the famous Summit Mine, mammoth coal bed, 60 feet thick, open quarry. In the gap notice the islet on which the very earliest anthracite iron furnace once stood. Good specimens of dendrites to be got from the plates in the mountain opposite the hotel. From here to Penn Haven, the fine gorge of the Lehigh, with its ox bow bend and walls of Catskill rocks. Glacial Moraine at Sand Run.

131. *Fair View*. Ascend 400 feet higher to the summit of Penobscot Knob, affording the finest view in the State. Notice the glacial scratches on the rock on the highest summit of the Knob. From here all the colliers are visible below, and the whole structure of the third anthracite coal field can be made out. Down Solomon's Gap by three incline planes, notice the erosion of the red shale under the conglomerate cover.

132. *Wilkesbarre*. Anthracite coal was first mined and used at Wilkesbarre in 1768 and 1769 by two blacksmiths named Gore. First shipment made to government arsenal at Carlisle in 1775.

133. *Falls*. Buttermilk Falls, not the falls of that name near Stroudsburg, but in nearly the same rocks, with the hollows filled with gravel.

134. *McKun's*. Enter the long gorge of the North branch of the Susquehanna through the Allegheny mountain plateau, capped (further west) by the Mehoopany coal basin.

135. *Wysauking*. A small but remarkable fault in the 11 b. Chemung rocks in the Wysox Narrows. It slants up the hillside and may be studied on the R. R. and on the common road, 200 feet above. The centre line of the Towanda anticlinal crosses the river at the northern end of this cliff, 1,050 feet above the fault.

136. *Towanda*. Fine cliffs, "The Red Rocks," just north of the fault and east from Wysauking station. Chemung fossils. Also another cliff directly opposite Towanda on east side of the river. Going north no such precipices are seen, the Chemung shales forming hills with rounded summits. Good view of Towanda village from the railroad. Boulders of white limestone from Central New York found in the river were formerly burnt for lime. Picturesque view at Ulster Narrows.

137. *Shenandoah*. The greatest overlap in the mammoth coal bed in the Anthracite region occurs in the Shenandoah City colliery. See Atlas of Geological Survey, where it is fully illustrated.

138. *Barclay*. Barclay or Towanda C. Co.'s, Long Valley and Shraeder Mines on the top of the Towanda Mountain, 1,300 feet above the river at Towanda. Incline planes. High falls. Profound gorges splitting the mountain. Laurel swamps. Semi-bituminous coal.

139. *W. Manayunk*. Beautiful ravine of the Wissahiccon to the east, deeply trenching the Azolc belt. Serpentine and soapstone quarries at Lafayette above Manayunk.

140. *W. Conshohocken*. Picturesque vertical trap dyke left standing in the limestone. Marble quarries east and west of here.

141. *Bridgeport*. On south edge of the Trias country. Bone cavern in limestone quarry near Port Kennedy studied by Dr. Leidy and Prof. Cope. Great limestone quarries south of the river, in one of which the trias beds are seen lying on the upturned edge of the old limestone beds.

142. *Valley Forge*. Ditto. The hill back of it is the east end of the ridge of Potsdam sandstone forming the north wall of the Chester Valley far to the south-west. Under its north flank come up the Azolc.

143. *Phoenixville*. In the tunnel here Mr. Wheatley found his coal plants (Trias) and reptile bones. Two miles south-west runs the edge of the Trias, with breccias, copper veins, etc., lying on Azolc. Trias continues hence to near Reading.

144. *Pottstown*. Trap hills to the north.

Philadelphia & Reading R. R.—Continued.			Philadelphia & Reading R. R.—Continued.		
Ms.	Lehigh and Susquehanna Division.	Alt.	Little Schuylkill, East Mahanoy, Mine Hill and Ms. Mahanoy & Shamokin Branches.		
75	Easton. ¹²⁵	3 a. Calciferous.	215	0 Herndon.	12 Catskill.
86	Bethlehem. ¹²⁶	"	235	14 Trevorton. ⁷⁶⁸	14 b. & c. An. Cl. Mres.
95	Catasauqua. ¹²⁷	4 a. Trenton.	283	21 Shamokin. ¹⁰⁸	"
109	Lehigh Gap. ¹²⁸	11 b. Chemung.	392	25 Excelsior.	"
120	Mauch Chk. ¹⁸⁰	13 b. Mch. Chk. r. s.	532	30 Mount Carmel.	"
127	Penn Haven Ju.	"	708	43 Ashland. ¹⁵³	"
145	White Haven.	12 Catskill.	1120	45 Girardville.	"
158	Penobscot. ¹⁸¹	"		47 Mahanoy. ¹⁵⁴	"
171	Ashley. ⁶⁸⁴	14 b. Anth's Coal Mres.		98 Tamaqua. ¹⁵⁵	"
174	Wilkesbarre. ⁵⁵⁰	"		102 Ringgold. ¹⁵⁶	5 b. Clinton.
183	Pittston. ⁵⁷¹	"		Chester Valley Branch.	
187	Spring Brook.	"		0 Bridgeport.	3 a. Califerous.
193	Scranton. ⁷⁴⁰	"		6 Centreville.	"
195	Green Ridge.	"		10 Cedar Hollow.	"
East Penna and Lebanon Valley Branch.				16 Exton.	"
0	Allentown. ¹⁵⁰	3 a. Calciferous.	481	22 Downingtown.	"
6	Emaus.	"	484	Schuylkill & Susquehanna Branch.	
10	Millerstown.	"	388	0 Auburn. ¹⁴⁸	9. Up. Helderberg.
15	Shamrock.	"	433	5 Hannon.	10. Hamilton.
18	Topton.	"	485	12 Rock.	"
25	Fleetwood.	"	449	18 Pine Grove.	11 b. Chemung.
31	Temple.	"	387	24 Ellwood. ⁶⁷³	13 b. Mauch Chu'k r. s.
36	Reading. ¹⁴⁶	"	268	30 Rausch Gap.	"
45	Wernersville.	"	388	35 Yellow Spring.	"
51	Womelsdorf.	"	456	38 Rattling Run.	"
58	Myerstown.	"	474	46 Forge.	"
64	Lebanon. ¹⁵¹	"	466	51 Dauphin.	"
69	Annaville.	"	442	54 Rockville. ^{8 349}	4 c. Hudson Riv. Slate.
74	Palmyra.	"	455	59 Harrisburg.	4 b. Utica Slate.
81	Hummelston. ¹⁵²	"	376		
90	Harrisburg.	4 b. Utica Slate.	321		

145. *Exeter.* Trap dikes to the south and west, across the river. Remarkable horseshoe ridge of trap to the east. See map of the South Mountains in Report D 3, Vol. II, Part 1, Atlas Geological Survey.

146. *Reading.* The "White Spot" high on the mountain to the east is a remnant of Potsdam sandstone left lying unconformably on Laurentian.

147. *Port Clinton.* A noble fault crosses the river three times in the gap; once at the canal locks, again at the rock at the west mouth of the old tunnel, and then runs vertically up the steep. Hudson River slates dipping 10° south abut against the bottom plate of Oneida standing vertical. Between this and Auburn very fine exposures of Clinton red shales. No fossil ore.

148. *Auburn.* Back of this, on the south side of Summer Hill, multitudes of Hamilton and Chemung fossils.

149. *Pottsville.* Center of the soft anthracite collieries. Fine geological headquarters. For four miles before reaching this place the whole Devonian and Bernician systems stand vertical, affording a section of 20,000 feet of rock up to the top of the lower productive coal series in the fold of the great synclinal in the lower part of the town. View from the top of Sharp Mountain, 800 feet high, instructive. Hotel at Mount Carbon close to where Dr. Isaac Lea found fossil footprints. See Note 169.

150. *Allentown.* Road runs along the base of the Laurentian Mountains over Calciferous limestone holding limonite beds.

151. *Lebanon.* Cornwall Magnetic Iron Mines six miles to the south; holds copper, trap and marble.

152. *Hummelton.* Iron mines, limonite, south of the town.

153. *Ashland.* Remarkable large fossil tree stems visible in the coal measures here. Glacial striae (?) cross white pebbles in the conglomerate crest of mountain west of the Ashland Gap, opposite Mt. Carmel.

154. *Mahanoy.* Large collieries. Shaft sunk by diamond drill.

155. *Tamaqua.* Little Schuylkill here makes a cross section of the Pottsville coal basin. Mr. C. A. Ashburner estimates that the center of the mammoth coal bed basin south of Tamaqua is 1800 feet deep.

156. *Ringgold.* From here down to Port Clinton the Little Schuylkill cuts through ten anticlinals.

157. *Union.* All along here the thinness of the Trias upon the Cambro-Silurian is revealed by erosion.

158. *Ironville.* Famous old and large limonite iron ore mine.

159. *Tremont.* View from the mountain to the southwest of it down the fish tail double red shale valley, split by the great mass of the Pocono rocks, is fine and instructive.

Philadelphia & Reading R. R.—Continued.			Philadelphia & Reading R. R.—Continued.		
Ms.	Schuylkill Valley Branch.	Alt.	Ms.	Catawissa and Williamsport Branch.	Alt.
0	Pottsville. ¹⁴⁹	14 b. & c. An. Cl. Mres. ⁶¹⁴	0	Philadelphia.	(See Main Line.)
4	Port Carbon.	" 639	78	Port Clinton. ¹⁴⁷	5 b. Clinton. 410
7	New Philadelp'a.	" 690	98	Tamaqua. ¹⁵⁵	14 b. & c. Cl. Mres. 503
13	Tuscarora.	" 909	107	Tamanend. ¹³⁰⁵	13 b. Mh. Ck. r. s. & s. s.
18	Tamaqua. ¹⁵⁵	" 803	114	Girard.	" 1407
Pickering Valley Branch.			118	Brand'nville. ¹⁶²	13 b. Mh. Ck. r. s. 1285
0	Phoenixville. ¹⁴³	16. Triassic. 110	124	Ringtown.	" 1129
11	Byers.	1. Azoic. 426	132	Beaver Valley.	" 924
Reading and Columbia Branch.			136	McAuley. ¹⁶³	" 759
0	Reading. ¹⁴⁶	3 a. Calciferous. 268	139	Mainville. ¹⁶⁴	12 Catskill. 672
6	Sinking Springs.	" 348	146	Catawissa.	Catskill-Chemung. 476
13	Reinholds.	16. Triassic. 449	154	Danville. ⁴⁷	5 b. Clinton. 494
16	Union. ¹⁵⁷	" 399	162	Moorestburg.	10 Hamilton. 618
20	Ephrata.	3 a. Calciferous. 384	167	Pottsgrove.	" 489
27	Litz.	" 375	170	Milton. ²⁷	6 Salina. 465
32	Manheim.	" 402	175	White Deer.	" 476
37	Landisville. ⁵	" 404	182	Montgomery.	11 a. Portage. 485
41	Ironville. ¹⁵⁸	2 b. Potsdam.	187	Muncy. ²⁸	5 b. Clinton. 494
46	Columbia. ⁵⁴	3 a. Calciferous. 250	190	Hall's. ⁵¹²	7 Lower Helderberg.
Lancaster and Quarryville Branch.			195	Montoursville.	10 Hamilton. 524
0	Lancaster Jun.	3 a. Calciferous. 371	199	Williamsport. ²⁹	11 a. Portage. 519
8	Lancaster.	" 312	Mill Creek and Mount Carbon Branch.		
14	West Willow.	" 449	0	Pottsville. ¹⁴⁹	14 b. An. Cl. Mres. 614
20	New Providence.	1. Azoic. 401	4	Dormer's.	" 647
23	Quarryville.	" 488	7	New Castle.	" 676
Lebanon and Tremont Branch.			12	Frackville.	" 1479
0	Brookside.	14 b. Anth. Coal Mres.	Colebrookdale Branch.		
13	Tremont. ¹⁵⁹	14 b. Coal Mres. 766	0	Pottstown. ¹⁴⁴	16 Triassic. 150
20	Pine Grove.	11 b. Chemung. 520	6	Colebrookdale.	1. Azoic. 816
24	Irving.	10. Hamilton. 499	13	Mt. Pleasant.	"
29	Murray. ¹⁶⁰	" 456	Philadelphia and Chester Branch.		
37	Jonestown.	4 c. Hudson River. 422	0	Eddystone.	1. Azoic.
44	Lebanon. ¹⁵¹	3 a. Calciferous. 466	4	Thurlow.	"
Mine Hill and Schuylkill Haven Branch.			Chestnut Hill Branch.		
0	Schuylkill Hav.	11 b. Chemung. 529	0	Philadelphia.	1. Azoic. 47
9	Minersville. ¹⁶¹	14 b. and Cl. Mres. 700	11	Chestnut Hill.	" 410
14	Glen Dower.	"			

160. *Murray*. Passing out of the gap Hole Mountain stands on the left (east) a curious synclinal outlier of Oneida capping a ridge of Hudson River, proving that no non-conformability exists.

161. *Minersville*. A line of great colleries on the mammoth vein extend westward. The gap of the west branch Schuylkill above Minersville, shows a superb arch of the conglomerate. Back of Mine Hill is the mine which burned for thirty years.

162. *Brandenville*. Making down grade from the conglomerate along the southern and western sides of the red shale valley of the Catawissa Creek crossed by numerous anticlinals from between the Beaver Meadow, Hasleton and Black Creek basins, to the east, and zigzagging the (Pocono) Catawissa Mountain to the west.

163. *McAuley*. A curious little oval mountain basin of anthracite lower coal beds (McCauley) stands out on the red shale plain to the right. Notice the rift in its southern side, and its fortress like outline.

164. *Mainville*. Fine gap through the Nescopic Mountain and section of white Pocono rocks with terraces of Red Catskill on its northern flank.

165. *Gwynedd*. Plants in the Trias as at Phoenixville. Trap ridge pierced by the tunnel.

166. *Coopersburg*. Saucon valley zinc mines.

167. *Steelton*. Bessemer steel works, Pennsylvania Steel Co.

168. *Cornwall*. Cornwall magnetic iron mines located here; this is the largest deposit of iron ore in Pennsylvania.

169. *Pottsville Ju.* The deepest shaft (1575 ft.) in Pa. is located here. The carboniferous conglomerate is boldly and beautifully exposed in the gap south of the town. The dip of the conglomerate is overturned and is toward the south, although the coal beds above the conglomerate lie in the synclinal to the north. See Note 145.

Philadelphia & Reading R. R.—Continued.			Philadelphia & Reading R. R.—Continued.		
Ms.	Schuylkill and Lehigh Branch.	Alt.	Ms.	Cornwall and Mt. Hope R. R.	Alt.
0 Reading. ¹⁴⁶	8 a. Calciferous.	268	0 Lebanon. ¹⁵¹	8 a. Calciferous.	
43 Slatington. ¹²⁸	4 c. Hudson Riv. s.l.	866	1 Donaghmore.	"	
North Pennsylvania and Bound Brook Div.			4 Midway.	"	
0 Philadelphia.	1. Azoic.	28	5 N. Cornwall.	"	
10 Abington.	"	254	6 Cornwall. ¹⁶⁸	"	
14 Ft. Washington.	16. Triassic.	170	7 Miners Village.	16 Trias.	
18 Gwynedd. ¹⁶⁵	"	271	8 Overlook.	"	
22 Landsdale.	"	268	9 Penryn.	"	
25 Hatfield.	"	311	12 Mt. Hope.	"	
31 Sellersville.	" and Trap.	331	People's Railway.		
38 Quakertown.	"	496	0 Pottsville. ¹⁴⁹	14 b. Coal Mres.	814
44 Coopersburg. ¹⁶⁶	"	549	5 Pottsville Ju.	"	
51 Hellertown.	3 a. Calciferous.	276	15 Tremont. ¹⁵⁹	"	
54 Bethlehem. ¹²⁶	"	287	Coudersport and Port Allegheny R. R.		
Bound Brook Route.			0 Coudersport.	12 Catskill.	1661
0 Philadelphia.	1. Azoic.	28	8 Olmstead.	"	
8 Jenkintown.	"	203	9 Pomery Bridge.	"	
15 Somerton.	"	156	13 Silver Spring.	"	
21 Langhorn.	16. Triassic.	96	17 Port Allegheny.	"	1481
29 Yardley.	"	79	Warren and Farnsworth Vy. R. R.		
88 Jersey City.	(See New Jersey.)		0 Clarendon.	13 a. Pocono s. s.	1396
Steelton Branch.			8 Underwood's.	"	
0 Harrisburg.	4 a. Trenton.	821	6 McCalmont.	"	
3 Steelton. ¹⁶⁷	"		8 East Branch.	"	
Germantown and Norristown Branches.			10 Garfield.	Carbonif. Cong.	
1 Philadelphia.	1 Azoic.	47	Nanticoke Branch.		
7 Germantown.	"	218	0 Wilkes Barre. ¹³²	14 Coal Mres.	550
School Lane.	"	108	8 Ashley.	"	634
Wissahickon.	"	89	5 Sugar Notch.	"	659
Schurz.	"	71	8 Hanover.	"	654
Shawmont.	"	69	12 Nanticoke.	50	540
Princeton.	"	62	13 Wanamie.	"	644
Lafayette.	"	53	Nescopeo Branch.		
Spring Mill.	3 a. Calciferous.	53	0 White Haven.	13 b. Mauch Ch'k.	1120
Potts.	"	63	8 Upper Lehigh.	14 Coal Mres.	1803
Magee's.	"	64	Drifton Branch.		
Norristown.	16 Trias.	75	0 Drifton Ju.	13 b. Mauch Ch'k r. s.	
Stony Creek R. R.			7 Council Ridge.	Carbonif. Conglomer.	
0 Norristown.	16 Trias.	62	8 Eckley.	14 Coal Mres.	
10 Lansdale.	"	362	10 Jeddo.	"	
North East Penna. R. R.			11 Drifton. ²⁰³	"	
0 Abington Ju.	1 Azoic.	259	Tamaqua Branch.		
Hillside.	2 b. Potsdam.		0 Mauch Ch'nk. ¹⁵⁰	13 b. Mauch C'k r. s.	533
4 Willow Grove.	3 a. Calciferous.	259	5 Nesquehoning.	"	801
Heaton.	16 Trias.		9 Hanto.	"	1005
7 Hatboro.	"	229	10 Lansford. ¹⁷¹	14 Coal Mres.	
10 Hartsville.	"	242	11 Coledale.	"	962
			15 Tamaqua. ¹⁵⁵	"	787

170 *Carlisle*. Trap dike 3 miles before reaching Carlisle; visible a long way off as a low mound across the great valley covered with trees, while all around is cultivation. West of Carlisle notice "Wagner's Gap" and "Doubling Gap" in the North or Blue Mountain. They are really not gaps but folds, caused by anticlinals passing through the mountain and elevating the vertical *6 a. Medina strata*. The mode in which this was done may be understood by holding up the edge of a sheet of paper in a perpendicular manner and then elevating it in one spot from beneath, which will cause the upper edge to fold in an S shape, similar to these so-called gaps.

Ms. Gettysburg & Harrisburg R. R. Alt.			Philadelphia & Baltimore Central, now Ms. Phila. Wilmington & Balt. R. R. Alt.		
0 Carlisle Junct'n.	4 a. Trenton	477	0 Philadelphia.	1. Azoic.	
8 Upper Mill. ¹⁷²	1. Azoic.		14 Lamokin Junct.	"	37
10 Hunter's Run.	1. Azoic.		20 Rockdale.	"	237
15 Laurel.	3 a. Calciferous.	413	25 Concord.	"	255
18 Pine Grove. ¹⁷³	"	1221	33 Fairville.	"	227
10 Hunter's Run.	1 Azoic.		40 Avondale.	"	506
15 Starner's.	"		46 Penn. ¹⁷⁵	"	
16 Idaville.	16 Trias.		52 Oxford.	"	
17 Gardener's.	"		112 Baltimore.	(See Maryland.)	
19 Bendersville.	"		Phila., Wilmington & Baltimore R. R.		
22 Sunnyside.	"		0 Philadelphia.	1. Azoic.	
23 Biglersville.	"		2 Gray's Ferry. ¹⁷⁶	"	36
26 Goldenville.	"		13 Chester. ¹⁷⁷	"	24
32 Gettysburg. ²⁰⁶	"		14 Lamokin.	"	37
Perkiomen Railroad.			16 Thurlow.	"	34
0 Perkiomen.	16 Triassic.	109	18 Linwood.	"	31
6 Collegeville.	"	155	20 Claymont.	"	29
11 Schwenksville.	"	152	22 Holly Oak.	"	9
14 Salford.	"		23 Bellevue.	"	14
18 Green Lane.	"	246	26 Edge Moor.	"	
22 Hanover.	"		28 Wilmington.	"	7
48 Allentown. ¹⁵⁰	3 a. Calciferous.	257	(Continued in Maryland.)		
Wilmington and Northern Railroad.			Chester Creek R. R.		
0 Reading. ¹⁴⁶	3 a. Calciferous.		0 Lamokin.	1 Azoic.	37
9 Birdsboro.	16. Triassic.	173	4 Knowlton.	"	
21 Springfield. ¹⁷⁴	1 Azoic.	645	5 Rockdale.	"	136
27 Waynesburg Ju.	"		6 Lenni.	"	
86 Brandywine.	"	556	7 Wawa.	"	
89 Coatesville.	4 a. Trenton.	315	Peachbottom Railroad.		
45 Laurel Iron W'ks.	1. Azoic.	241	0 Oxford.	1. Azoic.	
57 Chadd's Ford.	"	175	20 Dorsey. ¹⁷⁸	"	
72 Wilmington, Del.	(See Del. and Md.) ¹²		Buffalo, New York & Phila. R. R., now Western New York & Penna.		
Phila. Wilmington and Baltimore R. R. Central Division.			0 Buffalo.	(See New York.)	582
0 West Philadel'a.	1. Azoic.	14	78 State Line.	11 b. Chemung.	1438
7 Clifton.	"	109	88 Larrabees.	"	1481
14 Media.	"	210	96 Port Allegany.	"	1476
18 Linni.	"	136	107 Keating.	"	1876
27 West Chester.	"	406	114 Shippen. ⁸	"	1201
			121 Emporium. ³⁶	"	1019

171. *Lansford.* The Mauch Chunk red shale and Pottsville conglomerate are cut by a tunnel between Hanto and Lansford.

172. *Upper Mill.* Passes into the Papertown Gap of the South Mountains and turns to the right (S. W.), up the Mountain Creek Valley, with its range of old and extensive limonite mines, open quarries; ore heavily charged with manganese. Ride to the left (E.) over the divide, on which is Strickler's mine, and down to the Big bank. Very instructive. Over Strickler's, the mountain top is saddled with a 30-foot plate of Potsdam(?). In the Papertown gap beginning at the south end of Mt. Holly Springs Village are 3,000 feet (horizontal distance) of upturned quartzite rocks which belong perhaps to the Huronian system of Canada. These make the Mountain sandstone formation of Reports C and C2.

173. *Pine Grove.* Extensive, well arranged, limonite mine, planned by J. W. Harden.

174. *Springfield.* Warwick iron mine three miles to the east, on the edge of Trias; with trap, copper, etc. Jones' mine 1½ to the north at the east extremity of the Canastota belt of the Lancaster Co. limestone. French Creek copper mines further east than Warwick.

175. *Penn.* Line of serpentine to the left. Road runs along the belt, from Kennet Square for several miles. Great serpentine quarries at Avondale.

176. *Gray's Ferry.* Azoic Rocks here decomposed into kaolin.

177. *Chester.* The road runs on the edge of the Azoic, masked by drift all the way to Wilmington.

178. *Dorsey.* Roofing slate quarries at Peach Bottom on the Susquehanna River. Very remarkable fossil locality, the only one in the southern Azoic belt; apparently sea weeds, like *Buthotrephix* of the Hudson River slate formation.

B., N. Y. & P.—Continued.			B., N. Y. & P.—Concluded.		
Ms.	Buffalo and McKean Railroad.	Alt.	Ms.	Buffalo Division.	Alt.
0	Larrabees.	11 b. Chemung. 1476	0	Olean, N. Y.	11 b. Chemung. 1432
9	Smethport.	" 1493	11	Knapp's Creek.	" "
15	Colegrove.	12. Catskill. 1543	17	Red Rock, Pa.	12 Catskill.
22	Clermont. ¹⁷⁹	14 b. Coal Mres. 2074	22	Tarport.	11 b. Chemung.
Pittsburgh Division.			23	Bradford. ¹¹²	" "
0	Irvineton.	Oil Sand Group. 1165	51	Kinzua.	" "
9	Thompson.	" 1143	76	Portville, N. Y.	" "
15	Tidioute. ¹⁸⁰	" 1113	79	Bullis Mills, Pa.	" "
23	Hickory.	" 1091	84	Eldred.	" 1440
30	Tionesta.	" 1060	0	Eldred.	" 1440
41	Oleopolis.	" 1032	6	Duke Centre.	Chemung and Catskill.
50	Oil City.	" 1008	11	Summit City.	13 a. Pocono.
54	Rouseville.	" 1037	16	Sawyer.	11 b. Chemung.
55	Rynd Farm.	Sub-conglomerate 1042	18	Tarport.	" "
57	Columbia.	" 1067	19	Bradford. ¹¹²	" "
58	Petroleum Centre.	" 1089	7	Larrabees.	" 1478
60	Pioneer.	" 1099	Dunkirk, Allegheny Valley and Pitts-		
63	Miller Farm.	" 1130	burg Railroad.		
68	Titusville. ¹⁸¹	" 1194	0	Dunkirk.	(See New York.) 598
79	Centreville.	" 1296	47	Russellsburg.	11 b. Chemung. 1233
86	Spartansburg.	" 1455	55	Warren. ⁴²	Oil Sand Group. 1200
95	Corry. ⁴⁴	Oil Sand Group. 1433	61	Irvineton.	" 1164
Oil City and Ridgeway Railroad.			67	Pittsfield.	" 1245
Oil City.	11 b. Chemung. 1008		71	Garland. ⁴³	" 1293
Sidney's.	14 b. Coal Measures.		79	Newton.	" 1411
Union and Titusville Branch.			90	Titusville. ¹⁸¹	Sub-carbonife'us. 1181
0	Titusville. ¹⁸²	13 Sub-conglomer. 1194	Lake Shore & Michigan Southern R. R.		
8	Tryonville.	" 1320	436	Girard.	11 a. Portage. 717
16	Lincolnvile.	" 1381	441	Fairview.	" 735
25	Union City.	Oil Sand Group. 1270	451	Erie.	" 686
New Castle and Franklin Railroad.			459	Harbor Creek.	" 730
0	New Castle. ¹⁸²	14 a. Conglomerate. 793	466	North East.	" 804
9	Wilmington.	" 928	(Continued in Ohio.)		
16	Leesburg.	" 1045	Franklin Division.		
22	Mercer. ¹¹⁵	" 1097	36	Jamestown.	Sub-conglomerate. 990
30	Garvin's.	" 1327	45	Salem.	14 a. Conglomerate. 998
36	Stoneboro. ¹¹⁵	" 1171	52	Clark.	" 1164
57	Franklin. ¹¹⁵	Sub-Conglomer. 1017	57	Stoneboro. ¹¹⁵	" 1171
			65	Raymilton.	" 1138
			71	Summit.	" 1163
			78	Franklin. ¹¹⁵	Sub-conglom'rate 1017
			86	Oil City.	" 1010

179. *Clermont.* Coal mines on the highest land at the only practicable north and south pass over the great water shed between the Pennsylvania and New York waters.

180. *Tidioute.* The valley of the Allegheny River is full of derricks from here to Oil City; and the valley of Oil Creek up to Titusville.

181. *Titusville.* Here is the deepest of all oil wells, but unproductive.

182. *New Castle.* Old iron making centre. Banks of the river faced with terraces of Ferriferous limestone supporting large deposits of limonite ("buhr stone") iron ore, of the lower productive coal series.

183. *Kittanning.* Two Kittanning coal beds in the river hills low down; two Freeport coal beds high up. These constitute the chief beds of the Lower Coal Measures.

184. *Red Bank.* Between the mouth of the Mahoning and the mouth of the Redbank, the west-ermost of the great anticlinals, brings up the conglomerate 100 feet above water level. The anticlinal sinks 500 feet in 40 miles before reaching and crossing the Ohio River 4 miles below Pittsburgh.

185. *Brady's Bend.* Great iron works and iron and coal mines. Wells strike oil here 1,100 feet beneath the river bed in the third oil sand of the Venango oil group.

186. *Parkers.* High cliffs of conglomerate back of the town. A forest of oil well derricks on both river banks and on top of the cliffs. Here the Butler Co. oil belt crosses the river into Clarion County. Oil wells numerous at intervals all the way up to Franklin and Oil City.

187. *Sago.* Deep old oil wells. Very old iron furnace, centre of a former region of 50 charcoal blast furnaces.

Ms. Shenango and Allegheny R. R. Alt.			Allegheny Valley Railroad.—Continued.		
0 Greenville.	Sub.conglomerate.	961	Ms.	Plum Creek Branch.	Alt.
2 Shenango.	"	"	0 Pittsb'rgh. ²⁵ 745	14 b. & c. Barren Mres.	
6 North Hamburg.	14a Conglomerate.	1158	12 Ink Works.	14 b. Lower Coal Mres.	
12 Cool Spring.	"	1127	17 Coal Works.	"	
17 Mercer. ¹¹⁵	"	1108	Sligo Branch.		
38 Harrisville.	14b. Allegh'y R. Cl.	1340	0 Sligo Junction.	14 b. Lower Coal Mres.	
85 Centreville.	"	"	10 Sligo. ¹³⁷	"	1115
87 Branchton.	Conglomerate.		Pittsburgh, Ft. Wayne & Chicago		
38 Bovard.	"		Railway.		
48 Anandale.	"		0 Pittsburgh. ²⁵ 745	14 b. & c. Barren Mres.	
47 Hilliard.	14 b. Allegheny R. Cl.		18 Sewickley.	"	736
87 Branchton.	Conglomerate.		21 Baden.	706 14 b. Lower Coal Mres.	
Coaltown.	14 Coal Measures.		26 Rochester.	"	710
38 Keisters.	"		29 New Brighton.	"	750
41 Hallston.	"		35 Homewood. ¹⁸⁸	"	949
46 Euclid.	"		46 Enon.	"	994
49 Jamisonville.	"		(Continued in Ohio.)		
52 Oneida.	"		New Brighton and New Castle R. R.		
58 Butler.	"		0 Kenwood.	14 Coal Measurers.	
Allegheny Valley Railroad.			2 Fetterman.	"	
0 Pittsburgh. ²⁵	14b. Barren Mres.	745	5 Thompson.	Conglomerate.	
4 Sharpsburg.	"	745	9 Rock Point.	"	
10 Verona.	"	746	11 Chenton.	"	900
17 Parnassus.	"	768	12 Wampum.	"	801
21 Tarentum.	14b. Allegh'y R. Cls.	778	13 Wampum Ju.	"	
29 West Pa. Junct.	"	791	Erie and Pittsburgh R. R.		
35 Kelly's.	"	780	0 Erie. ¹⁸⁹	11 a. Portage.	685
44 Kittanning. ¹⁸³	14b. Lower Cl Mres.	810	11 Fairview.	"	735
48 Cowanesha'ock.	"	808	15 Girard.	"	697
55 Mahoning.	14a. Pottsv. Conglo.	824	20 Crosses.	11 b. Chemung.	765
64 Red Bank. ¹⁸⁴	"	830	26 Albion.	"	887
68 Brady's Bend. ¹⁸⁵	"	856	35 Conneautville.	"	1066
71 Catfish.	14 b. Lower Cl. Mres.	859	39 Summit.	"	1141
82 Parker's. ¹⁸⁶ 889	14a. Pottsville Conglo.	897	43 Linesville.	Sub-conglomerat.	1033
85 Foxburg.	"	905	47 Espyville.	"	1088
89 Emlenton.	"	905	56 Jamestown.	"	979
106 Scrubgrass.	"	944	63 Greenville.	"	961
115 Foster.	10 Sub-conglomer.	869	71 Clarksville.	"	894
123 Franklin. ¹¹⁸	"	988	77 Sharon. ¹⁹⁰	"	853
132 Oil City.	"	1009	83 Middlesex.	"	833
149 Titusville. ¹⁸¹	"		87 Pulaski.	"	826
188 Corry. ⁴⁴	Oil Sand Group.		94 Harbor Bridge.	"	816
Low Grade Division.			98 New Castle. ¹⁸²	14 a. Conglomerat.	809
0 Red Bank. ¹⁸⁴	14 b. Coal Mres.	851	150 Mahonington.	Sub-conglomerate.	789
15 Leathwood.	"	1027	151 Lawrence Junct.	"	774
20 New Bethlehem.	"	1080	154 Moravia.	Conglomerate.	806
40 Brookville.	"	1235	156 Newport.	"	813
55 Reynoldsville.	"	1377	157 Wampum.	"	801
70 West Summit.	"		160 Clinton.	"	900
77 Pennfield.	"		168 Homewood.	"	950
87 Tyler's.	"				
98 Grant.	12. Catskill.	995			
110 Driftwood.	"	814			

188. *Homewood.* Immense sandstone cliffs (at the base of the coal measures) wall in the valley of the Beaver. Homewood Furnace. Ferriferous limestone and ore all around.

189. *Erie.* Numerous gas wells used for lighting the city, heating, rolling iron, etc.

190. *Sharon.* The Sharon bed as a "block coal" raw fuel for iron furnaces becomes the great bed of Ohio; it is the lowest workable coal bed; overlies the Olean conglomerate, which is the lowest of the three divisions of the Pottsville conglomerate formation, No. XII. The coal bed is in the hill tops.

Ms. Ashtabula and Pittsburgh R. R. Alt.			Baltimore and Ohio R. R.—Continued.		
Wheeling and Pittsburgh Branch. Alt.			Ms.		
0 Pittsburgh. ²⁵	14 b. & c. Bar'n Mrs.	745	0 Pittsburgh. ²⁵	14 b. Barren Mrs.	
47 Lawrence Junc.	14 a. Potts. Conglo.	774	5 Glenwood.	"	760
57 Lowell.	"	826	11 White Hall.	14 c. Up. Cl. Mrs.	1188
(Continued in Ohio.)			19 Gastonville.	"	895
Cleveland and Pittsburgh Railroad.			21 Finleysville.	"	914
0 Pittsburgh. ²⁵	14 b. & c. Bar'n Mrs.	745	24 Crouches.	"	988
26 Rochester.	14 b. Lower Cl. Mrs.	710	84 Zediker.	"	1006
34 Industry.	"	701	38 Washington. ¹⁹⁹	"	1022
40 Smith's Fer'y. ¹⁹¹	"	699	45 Taylorstown.	"	1027
(Continued in Ohio.)			54 W. Alexander.	14 c. Coal Mrs.	1161
Pittsburgh, Cincinnati and St. Louis Railroad.			70 Wheeling, W. Va.	"	629
0 Pittsb'rgh. ²⁵	14 b. & c. Barren Mrs.	745	Somerset and Cambria Branch.		
8 Mansfield.	14 c. Up. Cl. Mrs.	778	0 Johnstown.	14 b. Low. Cl. Mrs.	1184
15 Noblestown.	"	926	7 Ingleside.	"	
23 Bulger. ¹⁹²	"	1156	9 Border.	"	
32 Hanlon's.	"	942	13 Bethel.	"	
(Continued in Ohio.)			19 Hooversville.	14 b. Barren Mrs.	1689
Chartiers Division.			23 Stoyestown.	14 b. L. Coal Mrs.	
0 Pittsb'rgh. ²⁵	14 c. Upper Coal Mrs.	745	38 Geiger's.	"	
8 Mansfield.	"	778	36 Somerset.	14 b. Barren Mrs.	
22 Canonsburg.	"	985	38 Roberts.	14 b. L. Coal Mrs.	
31 Washington. ²³¹	"	1081	40 Millford.	"	
Baltimore and Ohio Railroad. Pittsburgh Division.			42 Shamrock.	"	
0 Pittsb'rgh. ²⁵	14 b. & c. Bar. Cl. Mrs.	751	45 Rockwood.	Conglomerate.	
11 Port Perry. ⁹⁰	"	765	Fayette County Branch.		
15 McKeesport.	"	765	0 Connellsville. ⁷²	14 c. U. Coal Mrs.	594
22 Coulter'sville. ⁷⁶⁸	14 c. Upper Coal Mrs.		1 Gibson.	14 b. Barren Mrs.	
33 West Newton.	"	782	2 Fayette.	14 b. L. Coal Mrs.	921
40 Jacob's Cr'k. ⁷⁹⁷	14 b. & c. Bar. Cl. Mrs.		3 Watts.	"	921
49 Oakdale.	"	849	4 Dunbar. ⁷¹	"	1011
57 Connellsville. ⁷²	"	894	6 Mt. Braddock.	"	1175
65 Indian Creek. ¹⁹³	12. Catskill.	990	12 Lemont.	14 b. Barren Mrs.	1084
74 Ohio Pyle. ¹⁹⁴	14 b. Coal Mrs.	1237	13 Uniontown.	14 c. Up. Cl. Mrs.	952
84 Confluence. ¹⁹⁵	"	1346	Pittsburgh Southern Division.		
92 Pinkerton. ¹⁹⁶	"	1649	0 W. Pittsburgh.	14 b. Barren Mrs.	
101 Mineral Pt. ¹⁹⁷	"	1825	8 Banksville.	"	
109 Yoder's.	"		6 Mt. Lebanon.	14 c. U. Coal Mrs.	
116 Sand Patch. ¹⁹⁸	14 a. Pottsv. Congl.	1235	12 Castle Shannon.	"	
126 Glencoe.	12. Catskill.	1623	17 Upper St. Clair.	"	
135 Hyndman. ⁶²	10 Hamilton.	941	21 Library.	"	
141 Cook's Mills.	"	774	25 Finleyville.	"	
146 Mt. Savage Jun.	"	687	Mt. Pleasant Branch.		
150 Cumberland, Md.	7. Lower Helderb'g.	688	0 Mt. Pleasant.	14 b. Bar'n Mrs.	1057

191. *Smith's Ferry.* Numerous old oil wells producing a little from the conglomerate and sub-conglomerate.

192. *Bulger.* Prof. Stevenson's "Bulger anticlinal" crosses here. The Pittsburgh coal bed dwindles through to a small bed in Ohio, but grows thicker southwestward through Washington county into Greene county, as the new wells testify.

193. *Indian Creek.* Fine gorge of the Youghiogheny through Chestnut Ridge, walls 1,300 feet high. Pulpit rocks of Piedmont sandstone (top member of Pottsville conglomerate) left standing like stranded ships on the broad summit of the mountain. Dry oil wells and old salt wells in the floor of the gorge on the river bank. Cow rock on the southern brow of the gorge covered with the sculptures of the aborigines.

Huntingdon and Broad Top Mountain Railroad.			Ms.	East Broad Top Railroad. 207		Alt.
Ms.		Alt.				
0	Huntingdon. ¹⁵	621	0	Mt. Union. ²⁰⁸	{ 5 a. Medina.	597
7	Grafton.				8. Oriskany.	
15	Coffee Run.	872			10 a. Marcellus.	
24	Saxton. ²⁰⁰	849			10 b. Hamilton.	
81	Hopewell. ²⁰¹	898	4	Aughwich. 560	{ Oriskany Ridge	
43	Everett. ²⁰²	1118			on east.	
58	Bedford. ⁶¹	1062	7	Shirley.	Hamilton on w.	
			11	Rockhill. ²⁰⁹	10 a. Marcellus.	
Cumberland Valley Railroad.					"	624
0	Harrisburg.	322			{ 11 a. Portage.	
8	Mechanicsburg.	436	14	Beersville.	11 b. Chemung.	658
19	Carlisle. ¹⁷⁰	477			10 a. Marcellus.	
80	Newville.	533			8. Oriskany, cut.	
41	Shippensb'g. ²⁰⁴	654	18	Three Springs.	7 L. Helderberg l. s.	
52	Chambers'g. ²⁰⁵	618			5 b. Clinton anticlin.	
68	Greencastle.	585			6 Salina & Wat'lime.	
74	Hagerstown, Md.	572			7 L. Helderberg l. s.	
94	Martinsburg.	684			8. Oriskany.	
South Penn. Branch.					10 a. Marcellus.	
0	Chambersb'g. ²⁰⁵	618	20	Salttillo. 781	11 b. Chemung gap.	
7	Marion.				12. Catskill.	
9	So. Penn. Junct.	622			13 a. Pocono tunnel.	
15	Williamson.				13 b. Mauch Ck. r. s.	
19	Lehmaster's.				14 a. Pott. con. on top	
20	Mercersburg Ju.				13 b. Mh. Ck. r. s. E.	
22	Mercersburg.		25	Coles. 1359	tunnel.	
25	London.				14 a. & 14 b. on west.	
28	Richmond.		28	Cook's. 1541	13 b. Mauch Ck. r. s.	
Dillsburg Branch.					14 a. Conglomerate.	
0	Harrisburg.	322	31	Robertsdale. ²¹⁰	14 b. L. Cl. Series. ¹⁷⁸⁵	
8	Mechanicsburg.	427	Shade Gap Branch.			
9	Dillsburg.	542				
Hanover Junction, Hanover and Gettysburg Railroad.				Rockhill. ²⁰⁹	7 L. Helderberg.	624
0	Gettysburg. ²⁰⁶			Shade Gap.	5 b. Clinton.	
4	Granite.		Corning, Cowanesque and Antrim R. R.			
5	Gulden's.					
10	Oxford.		0	Corning.	11 b. Chemung.	942
13	Valley. ⁵⁷		15	Lawrenceville.	"	1006
17	Hanover.		23	Tioga.	"	1052
20	Smith's.		39	Wellsboro.	"	1319
22	Porter's.		51	Antrim.	{ 14 b. Semi-Bitumi's	
26	Jefferson.				Coal Mrs.	1672
27	Cold Spring.		15	Lawrenceville.	11 b. Chemung.	1006
28	Strickhauser's.		27	Elkland.	"	1142
30	Hanover Juno. ⁹⁸					

194. *Ohio Pyle.* Fine Cascade. The whole river falls over a horizontal plate of coal measure sandstone. Wild scenery all around. Coal bed 4 feet thick under the falls.

195. *Confluence.* The Turkey Foot. Junction of the three great branches of the Youghiogheny. Fort Hill, a very remarkable oval hill of coal measures terraced by coal bed outcrops all around as if artificially, several hundred feet high; its flat top, a field from which Indian skeletons have been ploughed up ever since the first settlement of the country.

196. *Pinkerton.* Fine mountain nose full of coal beds and terraced by sandstone of the barren measures.

197. *Mineral Point.* The fine isolated Pittsburgh coal bed basin of the Salisbury Ridge, to the south, capped with fossiliferous limestones of the upper coal measures. Romantic falls on Elk Lick Creek not far up from its mouth.

198. *Sand Patch.* Summit of the Allegheny Mountain.

199. *Washington.* Great gas and oil wells recently struck in this neighborhood.

200. *Saxton.* Turn in here to the Broad Top Coal Mines up Shoup's Run. Hotel at Broad Top City, as high as the top of the Allegheny Mountain. Fine scenery. Curious geology.

Corning, Coweneseque & Antrim R. R.—Con.			Delaware & Hudson Canal Co.—Con.		
Ms.	Pine Creek Division.	Alt.	Ms.	Gravity R. R.	Alt.
58	Corning, N. Y.		Carbondale.	14 b. An. Cl. Mres.	1015
98	Stokesville Ju.	1170	Head Plane, 1	Carboniferous,	1255
97	Matson's.		" " 2	Conglomerate,	1293
101	Ansonia.	1138	" " 3	Mauch Chunk,	1594
110	Tiadaghton.	11 b. Chemung.	" " 4	and Pocono.	1777
118	Blackwells. ²¹¹	875	" " 5		1938
123	Cedar Run.	802	" " 6		1921
128	Slate Run.		" " 7		1537
183	Ross.		Honesdale.	12 Catskill.	1093
184	Cammal. ²¹²	693	Bangor and Portland Ry.		
186	Miller's.		0 Portland.	4 c. Hudson River.	
189	Jersey Mills.	655	2 Mt. Bethel.	"	
143	Waterville. ²¹³	624	5 Johnsonville.	"	
146	Ramsey's.	606	9 Bangor.	"	
151	Safe Harbor.		10 Flicksville.	"	
155	Jersey Shore. ²⁰	7 L. Helderberg.	13 Ackermanville.	"	
157	Cement Hol'w. ²¹⁴	567	16 Pen Argyl.	"	
164	Linden.	511	19 Miller.	"	
168	Newberry Ju.	506	23 Stockertown.	"	
171	Williamsport. ²⁰		24 Tatamy.	"	
Addison & Northern Penna. Ry.			26 Nazareth.	4 a Trenton.	
0	Addison.	11 b. Chemung.	Beech Creek, Clearfield and South Western Railroad.		
5	Freeman's.	"	0 Philipsburg.	14 b. Bar'n Mres.	1425
11	Nelson.	"	15 Peale.	14 b Low Coal Mres.	
14	Elkland.	"	18 Gorton Heights.	"	
16	Osceola.	"	24 Snow Shoe Sum'it.	"	1617
21	Knoxville.	"	27 Snow Shoe.	"	
25	Coweneseque.	12 Catskill.	81 South Fork.	Conglomerate.	
27	Westfield.	"	87 Panther Run.	"	
81	Sabinesville.	11 b. Chemung.	41 Hayes.	Sub-Conglomerate.	
82	Summit.	"	46 Monument.	12 Catskill.	
85	Davis.	12 Catskill.	49 Mapes.	11 b Chemung.	
41	Gaines.	"	53 Beech Creek.	7 L. Helderberg.	616
46	Galeton.	"	59 Mill Hall.	"	
Delaware and Hudson Canal Co.			62 Lock Haven. ²¹	"	576
0	Carbondale.	14 b. Anthra. Coal Measures.	66 Wayne.	"	
7	Jermyn.	"	73 Jersey Shore. ²⁰	"	597
18	Dickson.	"	76 Larry's Creek.	10 b. Hamilton.	
16	Scranton.	"	81 Linden.	"	
		739	85 Newberry Juc.	7 L. Helderberg.	
			Newberry.	"	
			89 Williamsport. ²⁰	"	

201. *Hopewell*. Juniata flows in the red shale under cliffs of conglomerate on one side and a Pocono sandstone (terrace) mountain on the other. Iron works. Fine section up Yellow Creek into Morrison's Cove. Great outcrop of Hamilton limonite.

202. *Everett*. Long outcrop of Clinton fossil ore. Beautiful turnpike carriage drive, south, along the river, and over Wray's Hill, with wonderful sections of contorted Catskill all the way.

203. *Drifton*. The extensive coal mines of Hon. Eckley B. Cox, are clustered around Drifton.

204. *Shippensburg*. Five miles due east is a great spring rising at the south end of the limestone, and foot of the mountain; the head of Yellow Breeches Creek.

205. *Chambersburg*. Back-set of the mountains to the east and cross fault along the turnpike to Gettysburg. A mile or so south of the turnpike immense old limonite ore banks (Pond Bank, etc.) in which kaolin and lignite deposits occur like those of Brandon in Vermont. Five miles further south, in the foot slope of the mountain, are the Mont Alto ore banks. Back of Mont Alto in the mountains are magnetic ore beds, porphyry rocks, copper ores.

206. *Gettysburg*. "Round Top," "Cemetery Hill," "Macfarlane's Hill" and "Culp's Hill," forming the ridge on which the Union Army fought the great battle of Gettysburg, July 2d and 3d, 1863, are all trap dikes. Good place to study trap dikes. Scenery beautiful and full of historical interest. (See description of Triassic formation in Report C and C2.)

Ms. Williamsport & North Branch R. R. Alt.		Ms. Catasauqua and Foglesville R. R. Alt.	
Williamsport. ²⁹	7 Lower Helderberg.	0 Catasauqua. ¹²⁷	8 a Calciferous. 282
0 Halls.	" 512	3 Seiples.	" 465
2 Pennsville.	10 a Marcellus.	5 Guth's.	" 491
3 Lime Ridge.	7 Lower Helderberg.	6 Walbert.	" 550
4 Opp's Cross.	"	9 Chapman.	" 541
6 Hughesville.	10 b. Hamilton. 599	12 Trexlertown.	" 411
8 Bryan.	11 b. Chemung	14 Breinigsville.	"
9 Picture Rocks.	12 Catskill. 667	17 Lichty.	"
10 Lyon Saw Mill.	11 b. Chemung	18 Spring Creek.	" 382
11 Tivoli.	"	15 Alburtis.	" 455
13 Corson.	12 Catskill.	20 Rittenh'se Gp. ²¹⁵	Azoic. 940
14 Glen Mawr.	"	Cornwall & Lebanon & Colebrook Valley Railroads.	
16 Edkins.	"		
17 Strawbridge.	"		
19 Stroups.	"		
20 Muncy Vy.	"		
22 Sonestown.	" 945		

Bells Gap R. R.

0 Bells Mills. ¹⁸	10 a Marcellus. 1060	0 Conewago.	16 Trias.
2 Root's.	11 b. Chemung. 1222	1 Mt. Vernon.	"
4 Collier Siding.	12 Catskill. 1642	2 Aberdeen.	"
5 Shaw Run.	13 a Pocono.	3 Beverly.	"
6 Look Out.	Conglomerate. 1915	5 Bellair.	"
7 Rhododendron Pk	"	7 Flag.	"
8 Lloydsville.	14 b. L. Cl. Mres. 2180	8 Roseland.	"
13 Mountindale.	" 1965	10 Colebrook.	"
16 Glasgow.	" 1772	12 Mt. Gretna.	"
25 Irvona.	"	15 Cold Spring.	"
		16 Cornwall.	3 a Calciferous. 602
		19 Midway.	"
		22 Lebanon. ¹⁸¹	" 266

Bradford, Eldred and Cuba and Bradford,
Bordell and Kinzua Railroads.

0 Bradford. ¹¹²	11 b Chemung.	0 Latrobe. ²⁴	14 c. U. Cl. Mres. ¹⁰⁰⁵
Taylor.	12 Catskill.	3 Kingston.	14 b. Barren Mres.
9 Kinzua Jc.	13 a Pocono.	11 Ligonier.	14 b. L. Cl. Mres. ¹¹⁴⁸
Van Vlicks.	"	Meadville & Linesville R. R.	
Simpsons.	"		
Ormsbys.	Carbonif. Cong.	0 Meadville.	Oil Sand Group.
Smethport.	Catskill and Chemung.	1 Kerrtown.	Sub Conglomerate.
24 Eldred.	11 b Chemung.	3 Mercer Pike.	"
40 Bolivar.	"	7 Watson Run.	"
56 Wellsville.	"	9 West Vernon.	"
0 Cuba.	11 b Chemung.	12 Condeaut Lake.	" 1082
21 Bolivar.	"	15 Harmonsburg.	"
42 Richburg.	14 b L. Coal Mres.	16 Gehrton.	"
		17 Shermansville.	"
		21 Linesville.	" 1082

207 See Report F. of the second geological survey.

208. *Mt. Union.* Jack's Mountain on the west, 5 a. Medina, with 5 b. Clinton fossil ore on its flanks. Blue Ridge, 5 a. Medina in the distance on the east. End of Chestnut Ridge, southeast from station, composed of Lewiston on 9 Upper Helderberg limestone and 8 Oriskany sandstone.209. *Rock Hill.* On the east, Blacklog Mountain, 5 a. Medina. Shade Mountain also Medina. Blacklog valley between them, is anticlinal Chazy and Trenton limestone.210. *Robertsdate.* Coal openings on both sides of the railroad. The two upper seams worked, the lower seam not worked.211. *Blackwells.* Third Basin crosses about one and a half miles north. Flagstone quarry. The Terminal Meraime crosses this road near the station. A quarter of a mile below the mouth of Babb's Creek. A hill covered with boulders on the west side of Pine Creek, rises 100 feet above the creek. No similar accumulation occurs below this point. The creek flows in a deep gorge between nearly vertical cliffs of Catskill sandstone.212. *Cammel.* Second Basin crosses near this station.213. *Waterville.* First Basin crosses near here.214. *Cement Hollow.* Cement was produced here years ago.H. C. LEWIS.
A. HARDT, C. E.
A. H.
A. H.

Ms. Phila., Newtown & N. Y., R. R. Alt.			Ms. Lehigh & Lackawanna R. R. Alt.		
0 Philadelphia.	1 Azoic.		0 Bethlehem. ¹²⁶	3 a. Calciferous.	
8 Fox Chase.	"	190	4 Shimer.	"	
12 Huntington V'y.	"	117	5 Ritter.	"	
15 County Line.	"		7 Broadhead.	"	
16 Southamton.	"	239	8 Steuben.	"	
18 Churchville.	"	184	10 Clyde.	"	
19 Holland.	"		12 Bath.	4 a. Trenton Lime.	
28 Newtown.	16 Trias.	144	15 Chapman.	4 c. Hudson Riv. Slate.	
York & Peachbottom R. R.			17 Point Phillips.	"	
0 York.	8 c. Calciferous	321	20 Katellen.	"	
7 Dallastown.	Chlorite Schists.	657	22 Horn's Springs.	"	
9 Red Lion.	1 Azoic.	900	25 Wind Gap.	"	
14 Felton.	"	536	27 Pen Argyle.	"	
18 Laurel.	"	411	28 Hulls.	"	
21 Muddy C'k F'ks.	"	366	29 Bangor Junction.	"	
27 Woodbine.	"	294	30 Bangor.	"	
40 Peachbottom.	4 c. Hudson Riv. (?)	118	New York, Susquehanna & Western R. R.		
Harrisburg & Potomac R. R.			98 Del. Wat'r G'p. ¹¹⁶	5 b. Clinton	
0 Shippensb'g. ²⁰⁴	3 a. Calciferous Lime.		102 Stroudsburg. ¹¹⁷	10 a. Marcellus.	
5 Leesburg.	"		105 Gravel Place.	"	
7 Jacksonville.	"		Buffalo, Rochester and Pittsburgh R. R.		
9 Haysgrove.	"		107 Bradford Junc.	11 b. Chemung.	
11 Doner's.	"		120 Limestone.	"	
12 Huntzdale.	"		122 Babcock.	"	
14 Moore's Mill.	"		128 Kendall.	"	
17 Barnitz.	"		124 Bradford. ¹¹²	"	
19 Mt. Holly Springs.	"		127 Custer City.	"	
20 Gt. & Har. Cros'g.	"		129 Howard Jo.	"	
24 Boiling Springs.	"		Clarion Junction.	Sub-Conglomerate.	
25 Leidigh's.	"		Whistletown.	"	
27 Brandtsville.	"		174 Ridgway.	"	
29 Mech. & Dill's Jo.	"		182 Carmon.	"	
32 Bowmandale.	"		Short's Mill.	"	
Mont Alto R. R.			189 Forestville.	Conglomerate.	
0 Waynesboro.	3 a. Calciferous.	1200	192 Brockwayville.	14 b. L. Coal Mrs.	
1 Price's Church.	"		Lane's Mills.	"	
2 Nunnery.	"		195 Beech Tree Ju.	"	
3 Quincy.	"		200 Grove Summit.	"	
5 Zion.	"		204 Falls Creek.	14 b. Barren Mrs.	
6 Altodale.	"		206 Du Bois.	"	
7 Intersection.	"		Carlisle.	"	
9 Mt. Alto.	"	968	214 Sykes.	"	
11 Fayetteville.	"		Cramer.	"	
18 Font Hill.	"		Bells Mills.	"	
14 Woodstock.	"	715	228 Punxsutawney.	"	
15 Brookside.	"		229 Clayville.	"	
16 Junction.	"	714	231 Walston.	"	
20 Chambersb'g. ²⁰⁵	4 a. Trenton Lime.				

215. *Bittenhouse Gap.* Magnetic iron is mined along the terminus of this road. The ore is used by the Crane and Thomas iron companies.

216. *Sheffield.* The Hague gas well is located one and a half miles east of the town and is one of the most remarkable gas wells in Pa. (See Carll's report on Warren County, 14.)

217. *Chautau.* Good geological headquarters for studying XIII in hills and XII along wild gorge of Connoquenessing River. I. C. W.

218. *Youngstown.* In vicinity of Youngstown the Sharon coal which comes near the base of XII may be studied.

219. *Benfrew.* Near this is the celebrated Thorn Creek oil district, which has furnished the largest wells in America, one, the Boyd and Semple putting out 9,000 barrels the first 24 hours. I. C. W.

Ms. Sharpsville R. R.		Alt.	Ms. Pittsburgh & Lake Erie R. R.—Con. Alt.	
0 Sharpsville.	Sub-conglomerate.		43 Wampum.	Lower half of XII. 766
3 Mt. Hickory.	Conglomerate.		44 Newport.	Basal portion XII. 772
4 Hermitage.	"		46 Moravia.	" 786
5 Oakland.	"		49 New Castle Jc.	Base of XII. 795
6 Summit.	"		52 New Castle. ¹⁸²	"
7 Neshannock.	"		50 Mahoningtown.	" 800
9 Lackawan'ck Jc.	"		54 Edenburg. 798	13 d. Cuyahoga Shale.
12 Lyle.	"		57 Carbon.	" 808
15 New Wilmington.	"		59 Lowellville, O.	" 822
17 Wilmington Jc.	"		62 Struthers.	" 827
			68 Youngstown. 218	"
Tionesta Valley R. R.			Pittsburgh, McKeesport & Youghiogheny Railroad.	
0 Sheffield Junct.	13 a. Pocono.		0 Pittsburgh. ²⁵	14 b. Barren Mres. 780
6 Brookston.	"		5 Hayes.	" 755
10 Donaldson.	"		7 Homestead.	" 759
13 Sheffield. ²¹⁶	"		8 City Farm.	" 742
19 Garfield.	Carbonif. Conglom.		9 Rankin.	" 785
New York, Pittsburgh & Chicago R. R.			10 Braddock.	" 739
0 New Galilee.	14 b. Low. Cl. Mres.		Bessemer.	" 784
3 Darlington.	"		11 Port Perry. ⁹⁰	" 748
6 Cannellton.	"		12 Saltsburg.	" 742
9 Negley.	"		13 Demmler.	" 784
12 Mill Rock.	"		15 McKeesport. ⁹⁰	" 742
14 Rogersville.	"		19 Boston.	" 756
Pittsburgh & Castle Shannon R. R.			22 Greenock.	" 756
0 Pittsburgh. ²⁵	14 b. Barren Mres.		25 Stringtown.	" 762
9 Castle Shannon.	14 c. U. Coal Mres.		28 Scott Haven.	" 765
Pittsburgh & Lake Erie R. R. *			33 West Newton.	" 780
0 Pittsburgh. ²⁵	14 b. Barren Mres. 730		38 Port Royal.	" 735
5 Chartiers.	" 726		40 Jacob's Creek.	" 811
6 McKee's Rocks.	14 c. Mahoning s. s. 726		46 Layton.	" 853
7 Davis Island.	" 725		54 Dickerson Run.	" 878
11 Moon Run.	" 718		56 Broad Ford Jc.	14 c. U. Cl. Mres.
12 Montour Jc.	" 718		57 Broad Ford.	" 804
13 Middletown.	" 722		58 New Haven.	"
14 Lashell.	" 716		Montour Railroad.	
15 Stoop's Ferry.	" 719		0 Montour Junc.	14 b. Barren Mres. 718
17 Shousetown.	" 761		11 Imperial.	"
18 Shannopin.	14 b. L. Cl. Mres. 777		Pittsburgh, Chartiers & Youghiogheny Railroad.	
19 West Economy.	" 765		0 Pittsburgh. ²⁵	14 b. Barren Mres.
21 Woodlawn.	" 742		5 Chartiers.	"
22 Alliquippa.	" 756		12 Mansfield.	"
23 Logstown.	" 752		15 Bower Hill.	"
24 Stobe.	" 752		20 Beechmont.	14 c. U. Coal Mres.
25 Kiasola.	" 752		Pittsburgh & Western R. R.	
26 Monaca.	" 751		0 Allegheny. ⁷⁸	14 b. Barren Mres.
27 Phillipsburg.	" 752		3 Bennett.	"
Beaver.	" 752		5 Sharpsburg.	"
28 Bridgewater.	" 780		9 Elfinwild.	14 b. L. Coal Mres.
29 Fallston.	" 719		14 Wildwood.	"
31 Brighton.	14 a. Conglomer. 722		16 Gibsonia.	14 b. Barren Mres.
32 Beaver Falls.	14 a. Top of XII. 740			
34 College.	Middle of XII. 750			
36 Homewood. ¹⁸⁸	Lower half of XII. 749			
40 Clinton.	" 754			
Rock Point.	" 754			

*By Prof. I. C. White, U. S. Geologist.

Ms. Pittsburgh & Western R. R.—Con. Alt.		Ms. Pittsburgh & Western R. R.—Con. Alt.	
18 Bakerstown.	14 b. Barren Mres.	101 Lucinda.	14 b. Low. Coal Mres.
20 Valencia.	"	107 Tylersburg.	Conglomerate.
25 Callery Jc.	"	120 Warrensville.	"
28 Evans City.	14 b. Low. Coal Mres.	135 Sheffield Jc.	"
32 Harmony.	"	153 Kane.	Coal Measures
38 Zelienople.	"	157 Kanesholm.	"
48 North Sewickley.	"	164 Mt. Jewett.	"
45 Wurtemburg.	14 a. Conglom.	Waynesburg & Washington R. R.	
51 Chewton. ²¹⁷	"	0 Waynesburg.	14 c. Greene Co. Group.
54 Moravia.	"	5 Sycamore.	14 c. U. Coal Mres.
57 New Castle Jc.	"	7 Swart.	"
60 New Castle. ¹²²	"	9 Deer Lick.	"
58 Mahoningtown.	"	11 West Union.	"
62 Edenburg.	Sub-conglomerate.	12 Dunn.	"
67 Lowellville, O.	"	14 Lindley's Mills.	"
75 Youngstown. ²¹⁸	"	15 Hackney.	"
25 Callery Jc.	14 b. Barren Mres.	16 Johnson.	"
33 Renfrew.	"	18 Luellen.	"
40 Butler. ⁷⁹	14 b. L. Coal Mres.	19 Baker.	"
48 St. Joe.	"	21 McCracken.	"
53 Millerstown.	"	23 Vankirk.	"
57 Karns.	"	26 Braddock.	"
58 Petrolia.	"	29 Washington. ¹⁹⁹	"
62 Bruin.	"	Youghiogheny R. R.	
67 Parker.	Conglomerate.	Irwins.	14 c. U. Coal Mres. ⁸⁸⁴
70 Foxburg.	14 b. L. Coal Mres.	Shaft No. 2.	" 998
74 St. Petersburg.	"	Chambers.	" 1082
78 Turkey.	"	McGrew's.	" 981
86 Knox.	"	Millville.	" 867
91 Shippensburg.	"	Cowans.	"
95 Clarion Jc.	"	Marchands.	" 788
100 Clarion.	"	Sewickley.	" 780
98 Arthurs.	"		

Mineral Localities.

The following notes are taken from a list of Mineral Localities sent to the editor by Mr. Joseph Wilcox, of Media, Pennsylvania, one of the Commissioners of the Second Geological Survey.

P. W. & E. R. R. Swarthmore. At Avondale quarries, one mile south, Garnets and Tourmaline; one mile north, Andalusite.

Media. At Blue Hill, two miles north, Green Quartz, Chrysotile. In Upper Providence, Andalusite, Stellate, Antophyllite, Amethyst, Asbestos, Actinolite.

Elwyn. In Middletown, Actinolite, Green Feldspar, Corundum, Chromic Iron, Moonstone, Sunstone.

Bridgewater. Sphene.

Morgan. Amethyst, Corundum.

Rockdale. Amethyst, Asbestos.

Concord. Two miles south, in Green's Creek, Garnet (so-called Pyrope). Garnet mined as a substitute for emery.

Fairville. Mica in large crystals.

Rising Sun Station. Near New Texas in Lancaster Co., Chromic Iron has been largely mined. Brucite, Ripidolite, Picrolite, Emerald, Nickel, Williamsite, Genthite.

Brandywine Summit. Two miles southwest, Kaolin mines. Near Elam, Garnet, Mica, Feldspar.

Moore's. Near Moore's Ferry, Kyamite.

Chester Station. In Lelperville quarries, Garnet, Beryl, Feldspar, Tourmaline, Pink Zoisite, Mica.

Newport. At Brandywine Springs, Fibrolite.

West Chester. Two miles south at Brinton's quarry, Clinocllore, Jefferisite, Oligoclase. Serpentine is largely quarried there.

Wilmington and Northern R. R. Hall's. One mile and a half southwest, Corundum mines, Diaspore, Margarite, Garnet, Feldspar, Tourmaline.

P. E. R. Gap Station, Lancaster Co. Gap mine four miles, Millerite, Siderite, Chalcopyrite, Pyrrolite (niccoliferous.)

This blank space is intended for additional geological notes in pencil by the traveler.

Ohio.*

GEOLOGICAL FORMATIONS FOUND IN OHIO.

GROUPS.	OHIO SUB-DIVISIONS.	EQUIVALENTS IN OTHER STATES.
20. QUATERNARY.	{ 20 c. Stratified Drift. Terraces, &c., Valley Drift, Kames, Osars, &c. 20 b. Forest Bed (local). 20 a. Boulder Clay, Till, Erie Clay.	
14. COAL MEASURES AND CONGLOMERATE COALS.	{ 14 c. Upper Barren Measures. 14 c. Upper Productive " 14 b. Lower Barren " 14 a. and b. Lower Productive and Conglomerate Coal Measures.	{ Coal Measures of Pennsyl- vania, and Conglomerate Coals.
14. CONGLOMERATE (in part).	{ 14 a. Sharon Conglomerate.	{ Sharon Conglomerate of Pennsylvania.
13. SUB-CARBONIFEROUS LIMESTONE.	{ 13 f. Maxville Limestone.	Chester Limestone, Illinois.
13. WAVERLY.	{ 13 e. Logan Group, Olive Shales, Logan Sandstone, Waverly Conglomerate. 13 d. Cuyahoga Shale. 13 c. Berea (or Waverly) Black Shale. 13 b. Berea Grit. 13 a. Bedford Shale.	{ Shenango Sandstone in part, Pennsylvania. Marshall Group, Michigan. Crawford Shales, Pa. Orangeville Shale in part, Pennsylvania. Pithole Grit, or Third Moun- tain Sand, Pennsylvania.
11. OHIO (Black) SHALES.	{ 11 c. Cleveland Shale. 11 a. and b. Erie Shale. 10 c. and 11 a. Huron Shale.	{ Chemung, Portage, and Genesee, of New York.
10. HAMILTON.	{ 10 b. Hamilton Shale. Olentangy Shale.	{ Hamilton Group, New York (in part).
9. CORNIFEROUS.	{ 9 b. Delaware Limestone. 9 a. Columbus Limestone.	{ Marcellus Shale, Corniferous and Onondaga Limestones of New York.
6 & 7. WATERLIME.	{ 6 and 7. Waterlime.	{ Waterlime and L. Helder- berg, New York.
6. SALINA.	6. Salina Shales & Plaster Beds.	Salina Group, New York.
5. NIAGARA.	{ 5 h. Hillsboro' Sandstone. 5 g. Cedarville Limestone. 5 f. Springfield Limestone. 5 e. West Union Limestone. 5 d. Niagara Shale. 5 c. Dayton Limestone. 5 b. Clinton Limestone. 5 a. Medina Shale.	{ Niagara Group, New York. Clinton Group, New York. Medina Sandstone, New York.
4. HUDSON RIVER OR CINCINNATI.	{ 4 c. Lebanon Beds. 4 b. Cincinnati Beds. 4 a. Pt. Pleasant Beds.	{ Hudson River and Utica Shale of New York.

* In the first edition this chapter was furnished by Dr. J. S. Newberry, the State Geologist at that time. It has been very much enlarged for this edition, the new railroads added, the whole care-

Ashtabula and Pittsburgh Railroad.			Bellaire, Zanesville and Cincinnati R. R.		
Ms.			Ms.		In driftless region.
0 L. S. & M. S. R. R.					
1 Ashtabula.	11. Erie Shale.	650	0 Bellaire.	{	14 c. Upper Prod. Meas. Pittsburgh Seam, No. 8. 657
8 Austinburg.	"		12 Bethel.	{	14 c. Up. Barren Meas.
12 Eagleville.	"		33 Jerusalem.	"	"
16 Rock Creek.	"		42 Woodsfield.	"	"
24 Orwell.	" & 13. Waver.		49 Lewisville.	"	"
29 Bloomfield.	13 e. Waverly.		59 Summerfield.	"	"
34 Bristolville.	"		77 Caldwell.	"	"
40 Champion.	"		88 Cumberland.	{	14 b. Low. Barr. Meas. The Sewickly coal mined near known as Cumberland Seam.
45 Warren.	13 d. "	862		{	14 b. Low. Prod. Meas., Kittan. Coals, Nos. 5 and 6. 711
50 Niles.	14 a. Conglomerate.	911	110 Zanesville.		
55 Girard.	{ 18 Wav., 14 a. Congl., 14 b. Coal Meas. 866				
60 Youngstown.	14 a. Con. & Cl. Meas. 865				
65 Struthers.	14 b. Coal Measures.				
68 Lowell.	"				
Baltimore and Ohio and Chicago Railroad (B. & O. R. R.).			Central Ohio Railroad (B. & O. R. R.).		
0 Chicago Junc.			0 Baltimore, Md.		
8 Attica.	9. Cornif. & 10. Huron.		376 Bellaire.	{	14 c. C'l Meas. Pittsburgh S'm, No. 8. 657
16 Republic.	9. Corniferous.		385 Glencoe.	"	"
24 Tiffin.	5. Niag. & 7. Held. 753		395 Belmont.	{	14 c. Coal Meas. Up. Barren Measures.
30 Bascom.	5. Niagara.		408 Barnesville.	{	14 c. Coal Meas., Sewickly Seam, No. 86.
37 Fostoria.	"		413 Salesville.	{	14 c. Coal Measure.
44 Bloomdale.	5. Niag. & 7. Helderb'g.		423 Cambridge.	{	14 c. Coal Meas., Up. Freeport S'm, No. 7.
50 New Baltimore.	7. Helderberg.		437 Concord.	"	"
62 Deshler.	10 c. Huron Shale. 700		447 Sonora.	"	"
74 Holgate.	"		454 Zanesville.	{	14 c. Coal Meas. Kit. S'ms, Nos. 5 & 6. 711
88 Defiance.			468 Pleasant Valley.	{	13 c. "
94 Delaware.			470 Black Hand.	{	13 e. Waverly. 821
Strathtsville, Somerset and Newark R. R.			480 Newark. ¹	"	
0 Newark.	13 e. Waverly. 821		486 Union.	{	13 d. "
9 Avondale.	14 b. Coal Measures.		495 Pataskala.	"	"
17 Glenford.	{ 13 s. and c. Limestone and 14 a. Congl. "		504 Taylor's.	{	11 c. Hur. & 13 a. & b. Waverly.
27 Wellans.	"		513 Columbus.	{	9. Cornif., 10. Ham., 11. Ohio Shale. 746
38 Bristol.	{ 14 b. Coal Meas., Kittanning Seams, Nos. 5 and 6. 965				
43 Shawnee.	"				

fully revised, and about fifty foot-notes appended by Professor Edward Orton, the present State Geologist. Several additional glacial notes are by Rev. G. Frederick Wright, of Oberlin, one of the United States Geologists, who has been engaged under Professor T. C. Chamberlain in making a special survey of the terminal moraine through Ohio, Indiana, Kentucky, and Illinois. His notes are signed G. F. W., and all the other notes are by Professor Orton except No. 62. J. M.

- Newark. Glacial boundary at Newark. G. F. W.
- Chicago and Atlantic Railway. Route heavily covered with drift.
- Marion. Fine exposures of limestone in Marion quarries. Fossils abundant.
- Lima. Waterlime quarried here. Strong building-stone. Some beds fossiliferous.
- Winchester. Near margin of glacial drift.
- Mineral Springs. Springs derived from black shale.
- Miamisburg. Cedar trees and peat 100 feet beneath glacial deposits at Germantown, three miles southwest from Miamisburg. G. F. W.
- Amanda. Glacial boundary three miles east of Amanda. G. F. W.
- Lancaster. On the glacial boundary. Granite boulder two miles northeast, 18 x 11 x 6 feet out of ground. G. F. W.
- Bremen. Glacial boundary two miles northwest. G. F. W.
- Cecil. Region heavily covered with drift. Very few outcrops of strata to be found. These mainly in beds of streams.
- Greenville. At Greenville an interesting outcrop of Guelph division of the Niagara occurs, rich in fossils. A number of new species have been obtained here. The rock is dolomitic, but contains more carbonate of magnesia than carbonate of lime.

Ms. | Chicago and Atlantic Railroad.

0 Marion, Ohio. ³	9. Corniferous.	970
6 Espyville.	7. Waterlime.	956
7 Moran's.	"	
11 Clifton's.	"	971
16 Hepburn.	"	956
19 Dudley.	"	971
25 Kenton.	"	990
29 Sage.	"	998
33 Oakland.	"	994
35 Scioto.	"	999
38 Preston.	"	999
42 Harrod's.	"	1009
45 Westminster.	"	995
49 Townsend.	"	
52 Lima. ⁴	"	899
55 Shawnee.	"	862
58 Kemp.	"	855
61 Conant.	"	845
65 Spencerville.	"	848
72 Yorkville.	"	837
80 Enterprise.	9. Corniferous.	840
84 Glenmoore.	"	835
88 Greenwood.	"	836
92 Rivare, Ind.	"	847
96 Decatur, Ind.	"	820

Chicago, St. Louis and Pittsburg R. R.

0 Columbus.	{ 9 Cor., 10. Ham., & 10. Huron.	846
18 Pleasant Valley.	7. Helderberg.	
28 Milford Centre.	"	
38 Cable.	"	
47 Urbana.	7. Held. & 5 g. Niag.	1033
58 St. Paris.	5. Niagara.	
73 Piqua.	" & 5 c. Niag.	985
83 Bradford Junc.	5. Niagara.	
95 Greenville.	5 g.	1055
108 New Madison.	"	
114 New Paris.	5 f. Niagara.	
0 Bradford Junc.	"	
10 Pikeville.	"	
21 Union.	"	

(Continued in Indiana.)

Cincinnati and Eastern Railway.

0 Cincinnati. ⁶²	4 b. Cincin. Group.	507
14 Batavia.	"	
27 New Richm'd. ⁶²	"	
32 Williamsburg.	4 c.	"
40 Mt. Oreb.	"	
47 Sardinia.	"	
57 Winchester. ⁵	{ " & 5 a. & b. Niagara.	
62 Irvington.	4. Cincinnati Group.	
75 Mineral Spr'gs. ⁶	{ 11. Ohio Shale & 13 a. and b. Waverly.	
90 Henley.	13 d. Waverly.	
106 Portsmouth.	"	

Ms. | Cincinnati, Hamilton & Dayton R. R.

0 Cincinnati. ⁶²	4 b. Cincin. Group.	507
5 Cummins ville.	"	
15 Glendale.	"	
19 Jones.	"	
25 Hamilton.	"	604
37 Middletown.	4 c.	"
49 Miamisburg. ⁷	4.	"
60 Dayton.	4 c. & 5 a. b. c. Niag.	754

Cincinnati, Hamilton and Indianapolis Railroad.

0 Cincinnati.	4 b. Cincin. Group.	507
25 Hamilton.	"	604
32 McGonigle.	"	
39 Oxford.	4 c.	"
44 College Corn'rs.	"	

Cincinnati & Muskingum Valley Railroad.

0 Cincinnati. ⁶²	4 b. Cincin. Group.	507
36 Morrow.	4 b. & c.	642
46 Clarksville.	4 c.	"
56 Wilmington.	5 b. & c. Ni. & 5 c. Ni.	
66 Sabina.	5. Niagara.	
77 Washington.	7. Helderberg.	957
87 New Holland.	10 c. Huron Shale.	
95 Williamsport.	{ 10 c. Hur. Shale and 9 a. Corniferous.	
104 Circleville.	"	
116 Amanda. ⁸	13. Waverly.	
125 Lancaster. ⁹	13 e.	828
130 Bremen. ¹⁰	"	
134 New Lexington.	{ 14 b. Coal Meas., Kit. Coals, Nos. 5 & 6.	711
152 Roseville.	"	
157 Zanesville.	"	
168 Ellis.	"	737
176 Dresden Junc.	14 b. c. m. Mercer Horiz.	

Cincinnati, Richmond & Chicago R. R.

0 Cincinnati. ⁶²	4 b. Cincin. Group.	507
25 Hamilton.	"	604
36 Collinsville.	"	
44 Camden.	4 c.	839
53 Eaton.	5 d. & e. f. Niag.	1044
60 Florence.		
70 Richmond, Ind.	See Indiana.	

Cincinnati, Van Wert & Michigan R. R.

0 Cecil. ¹¹		
7 Paulding.	9. Cornif. & 10. Ham.	
19 Van Wert.	9. Corniferous.	788
43 Celina.	5 g. Niagara.	850
76 Greenville. ¹²	"	1055

Cleveland, Columbus, Cincinnati and Indianapolis Railroad.

0 Cleveland.	11. Erie Shale.	599
13 Berea. ⁶³	13 b. & c. Waverly.	795
25 Grafton.	"	803

13. Malvern. Glacial boundary five miles north. Glacial terrace extensive along Big Sandy Creek. G. F. W.

Cleveland, Columbus, Cincinnati and Indianapolis Railroad— <i>Con.</i>			Cleveland, Loraine and Wheeling Railroad— <i>Con.</i>		
Ms.			Ms.		
36 Wellington.	13 b. & c. Waverly.	861	72 Medina.	13 d. & e. Waverly.	
47 New London.	"	996	85 Grafton.	13 b. & c.	
55 Greenwich.	"	1050	16 Black River.	11. Ohio Shale.	
67 Shelby.	13 c.	1119	Cleveland, Akron and Columbus R. R.		
70 Vernon.	"		0 Hudson.	14 a. Conglomerate.	
76 Crestline.	"	1186	7 Cuyahoga Falls.	"	
80 Galion.	13 b.	1170	14 Akron.	"	
93 Gilead.	11 c. Cleve. Shale.	1041	27 Clinton.	{ 14 b. C. Meas., Sharon	
97 Cardington.	10 c. Huron Shale.	1012		{ Seam No. 1.	
104 Ashley.	"	987	38 Orrville.	13 e. Waverly.	1074
114 Delaware.	{ 9. Cornif., 10. Ham., &		52 Fredericksburg.	{ 13 e. Waverly, 14 a.	
	{ 10 c. Huron.	953		{ Con. Coal Meas.	
122 Lewis Centro.	10. a. & c. Hu. Shale.	962	61 Millersburg.	"	
129 Worthington.	"	915	81 Gann.	13 e. Wav., 14 a. Cong.	
138 Columbus.	{ 9. Cornif., 10. Hamil.,		90 Howard.	13 e. Waverly.	
	{ & 11. Ohio Sh.	745	100 Mt. Vernon.	"	991
Indianapolis Division.			109 Mt. Liberty.	"	
80 Galion.	13. Waverly.	1170	124 Sunbury.	13 a. & b. Waverly.	
92 Caledonia.	9. Corniferous.		133 Westerville.	{ 10 c. 11 a. b. c. Ohio	
101 Marion.	"	977		{ Shale.	931
111 N. Bloomington.	7. Helderberg.		145 Columbus.	{ 9. Cornif., 10. Ham.,	
123 Mt. Victory.	"			{ & 11. Ohio Sh.	476
132 Rushsylvania.	"		Cleveland and Pittsburgh Railroad.		
141 Bellefontaine.	{ 7. Held., 9. Cornif., &		0 Cleveland.	11. Erie Shale.	599
	{ 10 c. Huron.	1115	8 Newburg.	13 b. Waverly.	802
150 De Graff.	5. Niagara.		14 Bedford.	"	954
157 Pemberton.	"		26 Hudson.	14 a. Conglomerate.	
164 Sidney.	"	958	38 Ravenna.	14 b. Coal Measure.	
182 Versailles.	"		52 Limaville.	"	
190 Ansonia.	"		57 Alliance.	"	1099
197 Union.	"		63 Homeworth.	"	
Cincinnati Division.			69 Bayard. ¹⁴	{ 14 b. Coal Meas., Kit.	
0 Delaware.	{ 9. Cornif., 10. Ham.,			{ Seam, 5 and 6.	1078
	{ & 10 c. Huron.	953	81 Millport.	{ 14 b. C'l Meas., Free-	
9 Ostrander.	9. Corniferous.			{ port Seams, 6 a. & 7.	
17 Marysville.	7. Helderberg.		87 Salineville.	"	881
22 Milford.	"		94 Irondale.	"	6 a.
32 Mechanicsburg.	5. Niag. & 7. Helderb.		102 Wellsville.	{ 14 b. Coal Meas., Kit.	
43 Moorfield.	5. Niagara.			{ Seam, 5 and 6.	690
50 Springfield.	5 d. e. f. g. Niagara.		River Division.		
63 Osborn.	Cincinnati Group.		0 Bellaire.	14 c. Coal Measures.	657
74 Dayton.	{ 4 c. Cin. Group & 5 a.		6 Martin's Ferry.	"	
	{ b. c. Niagara.	754	13 Portland.	"	
81 Carrollton.	4 c. Cincinnati Group.		20 La Grange.	14 b.	
90 Franklin.	"		26 Steubenville.	{ 14 b. Coal Meas., L.	
99 Henderson.	"			{ Freeport Seam.	665
108 Maud's.	4 b.		35 Sloan's.	"	700
120 Carthage.	"		46 Wellsville.	{ 14 b. Coal Meas., Kit.	
180 Cincinnati.	"	507		{ Seams.	
Cleveland, Loraine & Wheeling Railroad.			Tuscarawas Branch.		
0 Uhrichsville.	{ 14 b. Coal Meas., Kit.		0 Bayard. ¹⁴	{ 14 b. Coal Meas., Kit.	
	{ Seam, 5 and 6.			{ Seams, 5 & 6.	1058
12 Dover.	"		8 Malvern. ¹³	{ 14 b. Coal Meas., Kit.	
23 Barr's Mills.	{ 14 b. Coal Meas., Mer-			{ Seams.	1001
	{ cer Horizon.		12 Waynesburg.	"	1001
35 Massillon.	{ 14 b. C. Meas., Sharon		23 Zoar.	{ 14 b. Coal Meas., Mer-	
	{ Seam No. 1.			{ cer S'ms, 3 & 5 a.	819
48 Warwick.	"		32 New Philad'a.	{ 14 b. Coal Meas., Kit-	
59 Russell.	13 a. Waverly.			{ tanning Seams.	906

Cleveland, Youngstown and Pittsburgh Railroad.

0 Mt. Union.	14 b. Lower Coal Meas.
15 Palmyra. ¹⁵	{ 14 a. Cong. and 14 b. Cong. Coal Meas.
22 Newton Falls. ¹⁶	44 a. Conglomerate. ⁹⁶⁸
27 Phalanx.	"

Columbus & Cincinnati Midland R. R.

0 Columbus.	9. Cor. & 11. O. Sh. ⁷⁴⁶
Mt. Sterling.	7. Waterlime.
Bloomingsburg.	"
Washington C.H.	" ⁹⁵⁷
Sabina.	5 g. Niagara.
Wilmington. ¹⁷	5 c. d. e. f. Niagara. ⁹⁹²
Clinton Valley.	4 c. Cincinnati Group.

Columbus and Eastern Railway.

0 Hadley Junc.	{ 13 d. Wav. Drift, de- posits heavy.
8 Thornport. ¹⁸	{ 13 c. Wav. Drift, near boundary of drift.
14 Glenford. ¹⁹	{ 13 f. Sub Carb. Lime. & 14 a. Conglom.
20 Mt. Perry.	{ 14 b. Low. Coal Meas., Mercer Horizon.
26 Fultonham.	"
35 Redfield.	{ 14 b. Low. Coal Meas., Kit. Coals, 5 & 6.

Columbus, Hocking Valley and Toledo Railroad.

0 Columbus.	{ 9. Corn. & 11. Ohio Sh., Drift heavy. ⁷⁴⁶
12 Groveport.	{ 11. Ohio Shale, Drift beds heavy.
23 Carroll.	13 d. Waverly. ⁸¹⁵
32 Lancaster. ²⁰	{ 13 d. & e. Wav., con- glom. prominent. ⁸²⁸
42 Millville.	{ 13 e. Wav., conglom. quarried largely.
50 Logan.	{ 13 e. Wav., type local- ity of Log. gr'p. ⁷³⁰
60 Lick Run.	{ 14 b. L. Coal Meas., Kit. Coals, Nos. 5 & 6. ⁶⁸³
62 Nelsonville. ²¹	"
70 Salina. ²²	{ 14 b. L. Coal Meas., Up. Freeport C'l. ⁶⁵⁹
76 Athens.	{ 14 b. L. Barren Meas., Crinord'l Limest. ⁶⁵⁶

Ohio River Division.

50 Logan.	13 e. Waverly. ⁷³⁰
58 Union Furnace.	{ 14 b. Con. Coal Meas., Mercer Horizon.
71 Creola.	{ 14 b. L. Coal Meas., Mer. Hor., Blockores
76 McArthur.	{ 14 b. L. Coal Meas., Ferrif. Limes & Hor.
84 Eagle Furnace.	"
93 Minerton. ²³	"
115 Gallipolis.	14 b. L. Barren Meas.
130 Middleport. ²⁴	{ 14 c. Up. Prod. Meas., Pittsburg Coal.
132 Pomeroy. ²⁵	"

Straitsville Branch.

0 Logan.	13 e. Waverly. ⁷³⁰
5 { Webb's Sum- mit. ²⁶	{ 13 f. Sub-Carbonifer- ous Limestone.
9 Oreville.	{ 14 b. L. Coal Meas., Ferrif. Limestone.
11 Straitsville.	{ 14 b. L. Coal Meas., Kit. Coal, No. 6. ⁷²⁶
Greendale.	{ 14 b. L. Coal Meas., Mercer Horizon.
Carbon Hill.	{ 14 b. L. Coal Meas., Kittanning Coal.
Snow Fork Junc.	"
Nelsonville.	" ⁶⁸³

Toledo Division.

0 Columbus.	9. Cor. & 11. O. Sh. ⁷⁴⁶
14 Powell's.	9. Corniferous.
24 Delaware.	9. Cor. & 11. O. Sh. ⁹⁵³
41 Owen's.	9. Corniferous.
46 Marion.	" ⁹⁷⁷
64 Up. Sandusky.	7. Waterlime, drift heavy
74 Carey.	5 g. Ni. & 7. Waterl. ⁸²⁰
88 Fostoria.	5 g. Niagara.
96 Rising Sun.	"
106 Pembersville.	"
124 Toledo.	7. Waterlime. ⁵⁸⁷

Columbus and Xenia Railroad.

0 Columbus.	{ 9. Cor., 10. Ham., & 11. Ohio Shale. ⁷⁴⁶
9 Alton.	9. Corniferous.
25 London.	" ¹⁰¹⁵
41 Selma.	5. Niagara.
55 Xenia.	{ 4 c. Cin., 5 a. b. and c. Niagara.

14. Bayard. Glacial boundary passes through Bayard. G. F. W.
 15. Palmyra. Sharon coal in valuable basins.
 16. Newton Falls. Fine development of conglomerate.
 17. Wilmington. Fine exposures of Clinton limestone in Todd's Fork, near Wilmington.
 18. Thornport. Near boundary of drift.
 19. Glenford. Fine quality of S. C. limestone quarried here. Carboniferous conglomerate ground for glass-sand near by.
 20. Lancaster. Glacial boundary passes through Lancaster. G. F. W.
 21. Nelsonville. Fine sections of lower coal measures.
 22. Salina. Salt manufacture; the Logan group furnishes the brine.
 23. Minerton. The Clarion or Ferriferous limestone coal is mined here.
 24. Middleport. Brown or paper coal found in the Pittsburg seam at one point.
 25. Pomeroy. Extensive mining of coal (Pittsburg seam) and manufacture of salt. Brine derived from Waverly conglomerate, Logan group.
 26. Webb's Summit. Typical locality of Sub-Carboniferous limestone for Ohio. Maxville is adjacent.

Ms. | Connotton Valley Railroad.			Ms. | Lake Erie and Western Railroad.		
0	Cleveland.	11. Ohio Shale. ⁵⁹⁹	0	Sandusky.	9. Corniferous. ⁶⁰⁰
12	Bedford.	{ 12 a. and b. Waverly. Typical locality for Bedford shale. ⁹⁵⁴	6	Castalia. ³¹	" ⁶⁰⁰
32	Kent.	14 a. Con. Massive. ¹⁰⁴⁹	28	Fremont.	7. Waterlime. ⁶³⁷
40	Mogadore. ²⁷	{ 14 b. L. Coal Meas., Mercer Horizon.	44	Fostoria.	5 g. Niagara.
60	Canton. ²⁸	" ¹⁰⁴⁹	60	Findlay.	5 g. Niag. & 7. Helder.
76	Minerva Junc.	{ 14 b. L. C'l Meas., Kif. C'l's, Nos. 5 & 6. ¹⁰¹¹	75	Bluffton. ³²	7. Waterlime.
87	Carrollton.	{ 14 b. L. Coal Meas., Up. Freeport C'l, No. 7.	91	Lima.	{ 7. Waterlime, drift heavy. ⁸⁷⁴
95	Dell Roy. ²⁹	"	112	St. Mary's.	" ⁸⁶³
102	Sherrodsville.	"	123	Celina.	" ⁸⁶⁰
			138	Fort Recovery.	"
Dayton and Michigan Railroad.			Lake Shore and Michigan Southern R. R.		
0	Cincinnati.	507	0	Buffalo, N. Y.	See New York.
60	Dayton.	{ 4 c. Cincin. Group, & 5 a. b. & c. Niag. ⁷⁵⁴	116	Conneaut.	11 a. and b. Erie Sh. ⁵⁵³
74	Tippecanoe.	Cincinnati Group.	129	Ashtabula.	" ⁶⁵⁰
87	Troy.	" ⁸⁴⁵	138	Geneva.	" ⁶⁶⁹
88	Piqua.	{ 4. Cin. Group, 5 a. Cin., & 5. Niag. ⁹³⁵	144	Madison.	" ⁷¹⁷
100	Sidney.	5 g. Niagara. ⁹⁰³	155	Painesville.	" ⁶⁵¹
119	Wapakoneta.	7. Helderberg. ⁸⁹³	174	Nottingham.	"
131	Lima.	" ⁸⁷⁷	183	Cleveland.	" ⁵⁹⁴
144	Columbus Grove	" ⁷⁶⁹	196	Berea. ⁶³	13 b. & c. Waverly. ⁷⁹⁵
161	Ottawa.	" ⁷³⁰	209	Elyria.	" ⁷³⁰
165	Deshler.	"	217	Oberlin.	" ⁸²⁷
176	Weston.	8. Orisk. & 9. Corn. ⁶⁸³	227	Wakeman.	" ⁷³⁰
182	Tontogany.	7. Helderberg.	239	Norwalk.	"
193	Perrysburg.	" ⁶⁸⁹	243	Monroeville.	11. Ohio Shale. ⁷³⁶
202	Toledo.	" ⁵⁸⁹	251	Bellevue.	" & 9. Cor. ⁷⁶⁶
			258	Clyde.	7. Helderberg. ⁷⁰⁸
			267	Fremont.	" ⁶³⁷
			279	Elmore.	5. Niagara.
			296	Toledo.	7. Helderberg. ⁵⁸⁹
			338	Wauseon.	11. Ohio Shale. ⁷⁷⁵
			353	Stryker.	" ⁷²¹
			360	Bryan.	" ⁷⁷³
			370	Edgerton.	" ⁸⁴⁵
			0	Elyria.	13 b. Waverly.
			10	Brownhelm.	"
			14	Vermilion.	11. Ohio Shale.
			21	Ceylon.	"
			34	Sandusky.	9. Corniferous. ⁶⁰⁰
			46	Port Clinton.	7. Helderberg.
			58	Oak Harbor.	5. Niagara.
			65	Graytown.	5 g. Niagara.
Dayton and Union Railroad.			Franklin Division.		
0	Dayton.	{ 4 c. Cin. Group and 5 a. b. c. Niag. ⁷⁵⁴	0	Ashtabula.	11. Erie Shale. ⁶⁶⁰
12	Brookville.	5 a. b. and c. Niagara.	11	Jefferson.	"
21	Baltimore.	5 f. Niagara.	24	Andover.	13. Waverly.
28	Arcanum.	"	30	Simon.	"
35	Greenville.	5 g. " ¹⁰⁵⁵	36	Jamestown.	See Penna.
47	Union.	"			
Indiana, Bloomington & Western R. R.					
0	Springfield.	5 d. and e. Niagara.			
11	Plattsburg.	5. Niag. and 7. Helder.			
20	London.	7. Helderberg.			
32	Georgesville.	9. Corn. and 7. Helderb.			
45	Columbus.	{ 9. Corn., 10. Ham., & 11. Ohio Shale.			

27. Mogadore. Coal measures clays worked on a large scale in potteries.

28. Canton. Road here passes out of drift-covered territory. The old moraine in great force near Canton.

29. Dell Roy. One of the best fields of Upper Freeport coal in State.

30. Nickel Plate. Much of the line is in a heavily drift-covered country. In the western part of Ohio particularly few exposures of the rocks are found.

31. Castalia. One of the strongest springs of Ohio.

32. Bluffton. Stone quarried extensively for railroad ballast.

33. Chillicothe. Glacial boundary two miles north. Glacial terraces extensive all along the river. Immense kames on Paint Creek, five miles west. (See Note 43.) G. F. W.

34. New Lisbon. Extensive glacial terraces containing kidney iron-ore. The glacial boundary is on the highlands just south. G. F. W.

Ms. | Little Miami R. R. (P. Cin. & St. L.).			Marietta, Pittsburg and Cleveland Railroad—Con.		
0 Cincinnati. ⁶²	4 b. Cincin. Group.	507	59 Cambridge.	{ 4 b. Coal Meas., Up. Freep't Sm., No. 7.	
9 Plainville.	"		70 Kimbolton.	{ 4 b. Coal Meas., Kit Seam, Nos. 5 & 6.	
17 Miami.	"		80 New Comerst'wn	"	798
28 Loveland.	4 b. & c.	642	90 Phillipsburg.	"	
36 Morrow.	4 c.		100 Dover.	"	888
45 Freep't.	"		"Nickel Plate." 80		
56 Claysville.	4 b. Cin., 5 a. b. & c. Nl.	880	New York, Chicago and St. Louis R. R.		
65 Xenia.			0 Buffalo.		
Marietta & Cincinnati R. R. (B. & O. R. R.).			116 Conneaut.	11. Ohio Shale.	650
0 Cincinnati. ⁶²	4 b. Cincin. Group.	507	129 Ashtabula.	"	652
5 Cummingsville.	"		138 Geneva.	"	
20 Remington.	"		154 Painesville.	"	651
31 Cozaddale.	"		160 Mentor.	"	654
41 Blanchester.	4 c.	979	165 Willoughby.	"	
50 Martinsville.	5 b. Niagara.	1045	173 Euclid.	"	
62 Lexington.	7. Helderberg.		183 Cleveland.	"	599
74 Greenfield.	"	898	192 Rocky River.	"	
85 Frankfort.	11. Ohio Shale.	765	202 Avon.	"	
98 Chillicothe. ³³	{ 11. Ohio Shale, and 13 a. and b. Wav.	637	210 Lorain.	"	
105 Schooley's.	13 d. Waverly.	668	221 Vermilion.	13 a. and b. Waverly.	
117 Raysville.	{ 14 a. Cong. & Cornif. Coal Meas.	638	229 Berlin Heights.	"	
127 Hamden.	14 b. Cong. C'l Meas.	723	236 Milan.	11. Ohio Shale.	766
139 Zaleski.	{ Coal Meas., Mercer & Kit., Nos. 3 to 6.	723	248 Bellevue.	7. Waterlime.	
152 Marshfield.	Camb. Limestone.	828	260 Green Springs.	5 g. Niagara.	
159 Athens.	Cam. & Crin. Limest.	656	280 Fostoria.	7. Waterlime.	
New England.	14 c. Coal Measure.		300 Mt. Comb.	"	
Cutler.	"	779	310 Leipsic.	"	
Moore's Junct.	"		325 Continental.	9. Corniferous.	
Marietta.	"	625	341 Latty.	"	
0 Blanchester.	4 c. Cincin. Group.	919	353 Smiley's Station.	"	
11 Lynchburg.	"		New York, Pennsylvania & Ohio R. R.		
21 Hillsboro.	5 c. d. e. f. g. h. Ni.	1135	0 Cincinnati. ⁶²		507
0 Hamden.	{ 13 a. c. Limest., 14 Coal Meas., Sharon Coal Horiz.		59 Dayton.	{ 4. Cincin. Group, & 5 a. b. & c. Niag.	754
12 Jackson.	{ 14 a. Cong. and Cong. Coal Measure.		70 Osborne.	4. Cincinnati Group.	
19 Vaughan's.	14 b. Coal Measure.		76 Enon.	5 d. and e. Niagara.	
28 Washington.	Coal Meas., Fer. Limest.		80 Springfield.	5 d. e. f. g.	910
38 Webster.	{ 14 b. Coal Meas., Mercer Horizon.		89 Bowlinville.	Niagara.	
50 Sciotoville.	13 e. Waverly.		95 Urbana.	5 g. Ni. & 7. Held.	1029
56 Portsmouth.	13 d.		105 Mingo.	7. Helderberg.	
0 Athens.	{ 14 b. Coal Measure, Crin. Limest.	656	114 Pottersburg.	"	
11 Guysville.	14 c. Coal Measure.		121 Broadway.	"	
23 Coolville.	"		129 Richwood.	"	844
28 Little Hocking.	"	757	138 Green Camp.	"	
36 Parkersburg.	"		144 Marion.	9 a. and b. Cornif.	961
Marietta, Pittsburg and Cleveland R. R.			153 Caledonia.	"	1068
0 Marietta.	14 c. Coal Measure.	625	164 Galion.	13 b. Waverly.	1171
7 Caywood.	"		172 Ontario.	13 c.	1377
18 Warner.	"		179 Mansfield.	13 e. Waverly.	1156
27 Dexter.	" Crin. Limest.		187 Windsor.	"	1069
36 Caldwell.	"		196 Ashland.	"	1086
45 Glenwood.	"		207 Polk.	"	1242
			218 West Salem.	"	1083
			216 Burbank.	"	
			221 Pike.	"	
			225 Russell.	"	

New York, Pennsylvania and Ohio Railroad—Con.			North-Western Ohio Railway.	
Ms.			Ms.	
232 Wadsworth.	14 b. Coal Meas.	1117	0 Toledo.	7. Helderberg. 889
240 New Portage.	14 a. Conglomerate.	967	6 Walbridge.	"
246 Akron.	"	1005	18 Woodville.	5. Niagara.
250 Tallmadge.	{ 14 b. Coal Measure,		26 Helena.	"
	{ Sharon Seam.	1102	31 Burgoon.	"
256 Kent.	14 a. Conglomerate.	1049	42 Tiffin.	" & 7. Held. 758
263 Ravenna.	14 a. & b. C'l Meas.	1095	52 Bloomville.	9. Corniferous.
269 Freedom.	"	1150	62 New Washington	10 c. Hur. & 10. Ham.
279 Braceville.	13 d. and e. Wav.	901	75 Vernon.	13 d. Waverly.
283 Leavittsburg.	13 d. & e. Waverly.	892	86 Mansfield.	13 e. " 1167
286 Warren.	3 d. Waverly.	902	Ohio Central Railway.	
294 Cortland.	"		0 Toledo.	7. Lower Helderb. 587
307 Orangeville.	13 c. and d. Wav.	945	10 Stony Ridge.	5 g. Niagara.
Mahoning Division.			35 Fostoria.	"
0 Sharon.	{ 14 a. & b. C'l Meas.,		69 Bucyrus.	11. Ohio Shale. 1009
	{ Sharon C'l, No. 1.		89 Mt. Gilead.	13 a. and b. Wav. 1100
7 Hubbard.	14 a. & b. Coal Meas.		108 Centerburg.	13 d. Waverly.
15 Youngstown.	{ 14 a. Cong. & 14 a. &		124 Granville.	13 e. "
	{ b. Sharon Coal No.		142 Lakeside. ³⁵	13 d. "
	{ 1.	865	156 Rushville. ³⁶	13 e. "
23 Niles.	"	911	167 Junction City.	14 b. Low. Mer. Horiz.
31 Leavittsburg.	"	897	172 New Lexington.	14 b. Kit. C'ls, 5 & 6. ²⁷¹
40 Mahoning.	14 a. Conglomerate.		179 Moxahala. ³⁷	"
51 Mantua.	"	1111	184 Corning. ³⁸	"
57 Aurora.	"	1090	Ohio and Mississippi Railroad.	
65 Solon.	"	1032	0 Cincinnati.	14 b. Cincin. Group. ⁵⁰⁷
75 Newburg.	13 a. Waverly.	815	9 Delhi.	"
80 Cleveland.	11. Erie Shale.	599	13 North Bend. ³⁹	"
Niles and New Lisbon Branch.			Ohio Southern Railway.	
0 Niles.	{ 13 d. Waverly and 14		0 Springfield. ⁴⁰	5 f. and g. Niagara. 953
	{ a. Conglom.	911		{ 5 f. & g. Ni. Drift
6 Austintown.	{ 14 a. & b. C'l Meas.,		12 S. Charleston.	{ heavy, no rock visible.
	{ Low. Merc. Horiz.			{ 7. Waterlime. No
12 Canfield.	{ Coal Meas., Ferrif.		36 Washington C.H.	{ rock visible. 957
	{ Limest. Horiz.	1100	43 Good Hope.	7. Waterlime.
18 Green.	{ Coal Meas., Low. Kit-		50 Greenfield. ⁴¹	" 898
	{ tanning Coal.	1036		{ 7. Waterl., 11. Ohio
23 Leetonia.	"		62 Bainbridge. ⁴²	{ Sh., 13 a. & b. Wav.
25 Franklin.	"		84 Waverly.	{ 11 c. Ohio Sh., 13 a.
	{ Coal Meas., Ferrifer.			{ b. and c. Waverly.
33 New Lisbon. ³⁴	{ Limest. to Mahon-		97 Beaverton.	13 e. Wav. & 14 a. Con.
	{ ing Sandstone. 968		109 Jackson. ⁴³	14 a. & b. Con. & C'l Meas.
Liberty and Vienna Branch.			113 Coalton. ⁴⁴	"
0 Vienna.	14 b. Coal Meas.		119 Wellston. ⁴⁵	"
8 Vienna Junct.	"			

35. Lakeside. Lake produced by glacial accumulations near margin of glacial area.

36. Rushville. The upper beds of the Waverly here yield an abundant series of fossils, part of them agreeing with the Sub-Carboniferous limestone forms of Illinois.

37. Moxahala. Between Moxahala and Corning the change occurs which converts the middle Kittanning coal seam (No. 6) from a 24 foot seam into a 10-12 foot seam. The Mid. Kittanning coal, and also the Lower Freeport seam, are both mined at Moxahala. In the tunnel south of the town the Upper Freeport horizon is well shown except the coal.

38. Corning. The Upper Freeport coal (No. 7) is also worked near Corning. It is known here as the "upper vein," or Norris coal.

39. North Bend. Extensive glacial deposits at North Bend railroad-tunnel, on the I. C. & L. R. R., passes through a glacial deposit 150 feet deep. G. F. W.

40. Springfield. Fine exposures of Niagara. Worked on large scale for building-stone and lime.

41. Greenfield. Best showing of Lower Helderberg in Ohio. Stone of great value. Quarried on large scale for building-stone. All fragments and spalls burned for lime; stone remarkably even bedded.

Ms. | Painesville & Youngstown R. R.

0 Youngstown.	{ 14 a. and b. Cong. & Cong. Coals. 865
9 Niles.	14 d. Conglomerate. 911
15 Warren.	18 d. Waverly. 892
25 Southington.	"
31 Bundysburg.	14 a. Conglomerate.
38 Burton.	"
48 Chardon.	"
59 Painesville.	11. Erie Shale. 695

Pittsburg, Cincinnati and St. Louis R. R.

0 Columbus.	{ 9. Corn., 10. Ham., & 11. Ohio Shale. 746
10 Black Lick.	18 b. Waverly.
17 Pataskala.	13 d. "
33 Newark. ⁴⁶	13 e. " 821
41 Hanover.	" 882
49 Frazeyaburg.	{ 14 b. Coal Meas., Mercer Horizon. 753
55 Dresden Junc.	" 737
62 Conesville.	{ 14 b. Coal Meas., Kit. Seams, 5 and 6. 740
69 Coshocton.	" 773
75 West Lafayette.	"
83 N. Comerston.	" 798
89 Pt. Washington.	" 815
97 Trenton.	" 835
100 Uhrichsville.	Coal Measures. 865
110 Bowerston.	C'l Meas., Freept S'ms. 1011
121 Fairview.	Coal Measures. 948
130 Unionport.	" 775
138 Smithfield.	" 720
150 Steubenville.	C'l M., L. Free. Sms. 720

Pittsburg, Fort Wayne & Chicago R. R.

0 Chicago.	See Indiana.
168 Dixon.	7. Helderberg. 800
178 Convoy.	" 793
181 Van Wert.	" 788
193 Delphos.	" 786
201 Elida.	" 800
208 Lima.	" 884
216 Lafayette.	" 938
222 Ada.	"
232 Dunkirk.	" 951
239 Forrest.	5. Niagara. 940
251 Upp. Sandusky.	7. Helderberg. 862

Pittsburg, Fort Wayne & Chicago Railroad—Con.

259 Nevada.	9. Corniferous. 934
267 Bucyrus.	{ 9. Cor., 10. Ham., & 11. Ohio Sh. 1009
280 Crestline.	13 d. Waverly. 1169
293 Mansfield.	13 e. " 1167
307 Perrysville.	" 1008
318 Lakeville.	{ 13. Wav., 14 c. Con., & 14 b. C'l M. 966
333 Wooster.	13 e. Waverly. 915
344 Orrville.	{ 13 e. Wav., 14 c. Con., & 14 b. C'l M. 1074
359 Massillon.	14 a. & b. Coal Mea. 967
367 Canton.	Coal M., Mer. Hor. 1059
379 Strasburg.	Coal Measure. 1101
385 Alliance.	" 1099
392 Damascus.	" 1190
405 Leetonia.	{ Coal Meas., L. Kit. Seam, No. 5. 1036
414 N. Waterford. ⁴⁷	Freeport Seams. 1078

(Continued in Pennsylvania.)

Sandusky, Mansfield and Newark Railroad (B. & O. R. R.).

0 Sandusky.	9. Corniferous. 600
8 Prout's.	11. Ohio Shale.
15 Monroeville.	11 c. Ohio Shale. 736
23 Havana.	13 b. Waverly.
28 Chicago Junc.	13 c. "
35 Plymouth.	"
42 Shelby Junc.	" 1119
49 Spring Mill.	"
54 Mansfield.	13 e. " 1167
63 Lexington.	"
74 Independence.	"
84 Frederick.	"
91 Mt. Vernon.	" 991
103 Utica.	"
116 Newark. ⁴⁶	" 821

Scioto Valley Railroad.

0 Columbus.	{ 9. Cor., 10. Ham., 11. Ohio Shale. 746
80 Circleville.	{ 11. Ohio Sh. Whole region heavily covered with drift.
39 Kingston.	13 d. Waverly.

42. Bainbridge. Sections from Helderberg limestone to Berea grit found in steep hills. The Ohio shale is fossiliferous here to small extent. The valley of Paint Creek has unusual geological interest.

43. Jackson. The lowest coal of the series is mined largely here. It has great excellence as an iron-making fuel. Four furnaces depend upon it.

44. Coalton and Wellston. At these places is the only field of the State in which the second seam of the coal series is worked. The coal has great excellence and value. It is also an iron-making fuel in the raw state.

45. Barr's Mills. Glacial boundary passes through Barr's Mills. G. F. W.

46. Newark. Glacial boundary passes through Newark, running north and south. G. F. W.

47. North Waterford. Glacial boundary five miles south. Glacial deposits extensive at East Palestine. G. F. W.

48. Chillicothe. The road here passes out of the glacial area. At Chillicothe all divisions of Waverly well shown. (Also see No. Note 33.)

49. County Bridge. At this point fine exposures of Waverly black slate.

50. Waverly. From Waverly the division of rocks received its name, the main element being the quarry-stone, which is the southern extension of the Berea grit.

51. Sciotoville. At Sciotoville the famous Sub-Carboniferous fire-clay that accompanies the limestone is largely worked and manufactured.

Scioto Valley Railroad—Con.			Toledo, Cincinnati and St. Louis Railroad—Con.		
Ms.			Ms.		
50	Chillicothe. ⁴⁸	{ 11 c. Ohio Sh., 13 a. b. c. d. e. Wav. ⁶³⁷	80	Jamestown.	{ 5. Niagara. Drift beds heavy.
61	Country Bridge. ⁴⁹	{ 13 b. c. & d. Waverly.	66	Frankfort.	{ 11. Ohio Shale. ⁷⁶⁵
70	Waverly. ⁵⁰	{ 11 c. Ohio Sh., & 13 a. b. c. Waverly. ⁵⁷⁸	80	Chillicothe.	{ 11. Ohio Sh. & 13 a. b. c. d. e. Wav. ⁶³⁷
76	Piketon.		93	Richmondale.	{ 14 a. Con. & 13 e. Wav.
90	Lucasville.	13 c. d. e. Waverly. ⁴⁸⁹	104	Byers' Station.	"
100	Portsmouth.	13 e. " ⁴⁸⁹	110	Coalton.	{ 14 a. & b. Con. & C'1 M.
106	Sciotoville. ⁵¹	{ 13 e. Wav., 13 f. Sub- Carb. Limestone.	115	Wellston.	"
114	{ Franklin Fur- nace.	{ 14 a. and b. Coal Measures.	115	Wellston.	"
124	Hanging Rock.	{ 14 b. Coal Meas. and Ferri. Limestone.	136	Centerton.	{ 14 b. Coal Measures.
127	Ironton. ⁵²	{ 14 b. Coal Meas., Kit. Coals, 5 and 6.	152	Mt. Vernon.	{ 14 b. Coal Meas., Fer. Limestone.
131	Ashland.	"	159	Etna.	"
			168	Ironton.	"
Toledo, Cincinnati & St. Louis Railroad.			Valley Railway.		
0	Toledo.	7. Waterlime. ⁵⁸⁷	Cleveland.	11. Ohio Shale. ⁵⁹⁹	
24	Grand Rapids.	9. Corniferous.	Independence. ⁵⁶	13 a. b. c. Waverly.	
42	Holgate.	"	Peninsula. ⁵⁷	"	
74	Delphos.	{ 7. Waterlime. Drift heavy. ⁷⁸⁶	Akron.	{ 14 a. Cong. and 14 b. Coal Measure. ¹⁰⁰⁵	
108	Decatur.	9. Corniferous.	Greentown.	{ 14 b. Brookville or Gray Limest. Coal	
74	Delphos.	7. Waterlime. ⁷⁸⁶	Canton. ⁵⁸	14 b. Merc. Horiz. ¹⁰⁴⁹	
92	Mendon.	"	No. Industry.	14 b. Kit. Cls., No. 5 & 6.	
104	Celina.	5 g. Niagara. ⁸⁵⁰	Mineral Point. ⁵⁹	"	
139	Covington.	5 f. & g. "	Valley Junc.	14 b. Mercer Horiz. ⁹⁰⁰	
150	West Milton.	5 b. "			
156	Harrisburgh. ⁵³	"			
169	Dayton. ⁵⁴	{ 4 c. Cin. & 5 a. b. c. d Niagara. ⁷⁵⁴	Wabash, St. Louis and Pacific Railroad.		
183	Centerville.	"	0	Toledo.	7. Helderberg. ⁵⁸⁷
199	Lebanon. ⁵⁵	4 c. Cincinnati. ⁷⁴⁰	0	South Toledo.	"
207	Mason.	4 b. & c. " ⁷⁰⁰	17	White House.	9. Corniferous. ⁶⁵⁴
229	Cincinnati. ⁵²	4 b. " ⁵⁰⁷	29	Liberty.	10 c. Huron. ⁶⁸⁴
			35	Napoleon.	10. Ham. & 11. O. Sh. ⁶⁸²
0	Dayton.	{ 4 c. Cincin. and 5 a. b. c. d. Niag. ⁷⁵⁴	52	Defiance.	" ⁷⁰⁰
17	Xenia.	{ 4 c. Cincin. and 5 a. and b. Niagara.	61	Emerald.	10. Hamilton.
			71	Antwerp.	9. Corniferous. ⁷³²
			94	Ft. Wayne.	See Indiana.

52. Ironton. The charcoal iron manufacture of Ohio is centered here.

53. Harrisburgh. Clinton limestone, white and marble-like here.

54. Dayton. Junction of Lower and Upper Silurian well shown at Soldiers' Home. Valuable quarries in Dayton stone at many points. The Clinton limestone highly fossiliferous in this region.

55. Lebanon. One of the typical localities for fossils of the Upper Cincinnati beds.

56. Independence. Valuable quarries in Berea stone. Grit especially valuable for millstones for grinding wood pulp, pearl barley, etc.

57. Peninsula. Large quarries in Berea grit.

59. Mineral Point. Valuable bed of Kittanning clay. Best fire-clay in the State.

60. Lodi. Excellent locality for Upper Waverly fossils.

61. Massillon. Lowest coal (Sharon) mined largely here.

62. The Cincinnati Glacial Dam. The survey of the terminal moraine in Ohio, made by Rev. G. F. Wright in 1882, proved that the southern boundary of the great ice-sheet crossed the Ohio River near New Richmond, twenty-two miles by the river above Cincinnati, and extended across the northern counties of Kentucky, four or five miles south of the river, recrossing the Ohio near Aurora, Indiana. Mr. Wright inferred that one effect of this glacier was to form an immense dam of ice and moraine debris, 500 to 600 feet high, which effectually closed the old channel of the Ohio for forty-nine miles by the windings of the river, and set back the water of the river and its tributaries until, as shown by Mr. I. C. White, it probably occupied the channel between the Kanawha and the Ohio Valleys, through West Virginia, now the line of the Chesapeake and Ohio Railroad. The site of Pittsburgh, Pa., was submerged to the depth of 800 feet, the remarkable terraces in the valleys of the Ohio, Allegheny, Monongahela, and other branches, for the origin of which no satisfactory explanations had before been given, being then formed, according to White and Lesley, around the shores of this great inland lake. (See Note No. 62, in West Virginia.) J. M.

Ms. | Wheeling and Lake Erie Railway.			Ms. | Wheel'g & Lake Erie Railway—Con.		
0 Toledo.	7. Waterlime.	587	133 Sippo.	{ 14 a. Congl. & 14 b.	
36 Fremont.	7. Waterlime.	637		Lower Coal Meas.	
59 Monroeville.	11. Ohio Shale.	736	137 Massillon. ⁶¹	{ " 967	
64 Norwalk.	13 a. & b. Waverly.		143 Navarre.	{ 14 b. Con. Coal Meas.,	
85 Wellington.	13 d. Wav. D'ft h'vy. ⁸⁶¹			Mercer Horizon.	
100 Lodi. ⁶⁰	13 d. & e. Waverly.		154 Zoar.	{ " 891	
121 Orrville.	13 e. Waverly.	1074	157 Valley Junction.	{ "	

63. The Berea Grit, the most important member of the Sub-Carboniferous formation in Ohio, is quarried here on a very large scale. The Berea Shale that makes the roofs of the quarries is highly fossiliferous.

Scioto Valley Railroad— <i>Con.</i>			Toledo, Cincinnati and St. Louis Railroad— <i>Con.</i>		
Ms. |			Ms. |		
50 Chillicothe. ⁴⁸	{	11 c. Ohio Sh., 13 a. b. c. d. e. Wav. ⁶³⁷	80 Jamestown.	{	5. Niagara. Drift beds heavy.
61 County Bridge. ⁴⁹	{	13 b. c. & d. Waverly.	66 Frankfort.	{	11. Ohio Shale. ⁷⁶⁵
70 Waverly. ⁵⁰	{	11 c. Ohio Sh., & 13 a. b. c. Waverly. ⁵⁷⁸	80 Chillicothe.	{	11. Ohio Sh. & 13 a. b. c. d. e. Wav. ⁶³⁷
76 Piketon.			93 Richmondale.	{	14 a. Con. & 13 e. Wav.
90 Lucasville.		13 c. d. a. Waverly. ⁴⁸⁹	104 Byers' Station.		"
100 Portsmouth.		13 e. " "	110 Coalton.	{	14 a. & b. Con. & C'1 M.
105 Sciotoville. ⁵¹	{	13 e. Wav., 13 f. Sub-Carb. Limestone.	115 Wellston.		"
114 { Franklin Fur-nace.	{	14 a. and b. Coal Measures.	115 Wellston.		"
124 Hanging Rock.	{	14 b. Coal Meas. and Ferrif. Limestone.	136 Centerton.	{	14 b. Coal Measures.
127 Ironton. ⁵²	{	14 b. Coal Meas., Kit. Coals, 5 and 6.	152 Mt. Vernon.	{	14 b. Coal Meas., Fer. Limestone.
131 Ashland.		"	159 Etna.		"
			168 Ironton.		"
Toledo, Cincinnati & St. Louis Railroad.			Valley Railway.		
0 Toledo.	7. Waterlime.	⁵⁸⁷	Cleveland.	11. Ohio Shale.	⁵⁹⁹
24 Grand Rapids.	9. Corniferous.		Independence. ⁵⁶	13 a. b. c. Waverly.	
42 Holgate.	"		Peninsula. ⁵⁷		
74 Delphos.	{ 7. Waterlime. Drift heavy. ⁷⁸⁶		Akron.	{ 14 a. Cong. and 14 b. Coal Measure. ¹⁰⁰⁵	
108 Decatur.	9. Corniferous.		Greentown.	{ 14 b. Brookville or Gray Limest. Coal	
74 Delphos.	7. Waterlime.	⁷⁸⁶	Canton. ⁵⁸	14 b. Merc. Horiz. ¹⁰⁴⁹	
92 Mendon.	"		No. Industry.	14 b. Kit. Cla., No. 5 & 6.	
104 Celina.	5 g. Niagara.	⁸⁸⁰	Mineral Point. ⁵⁹	"	
139 Covington.	5 f. & g. "		Valley Junc.	14 b. Mercer Horiz. ⁹⁰⁰	
150 West Milton.	5 b. "		Wabash, St. Louis and Pacific Railroad.		
156 Harrisburgh. ⁵³	"		0 Toledo.	7. Helderberg.	⁵⁸⁷
169 Dayton. ⁵⁴	{ 4 c. Cin. & 5 a. b. c. d. Niagara. ⁷⁸⁴		0 South Toledo.		
183 Centerville.			17 White House.	9. Corniferous.	⁶⁵⁴
199 Lebanon. ⁵⁵	4 c. Cincinnati.	⁷⁴⁰	29 Liberty.	10 c. Huron.	⁶⁸⁴
207 Mason.	4 b. & c. "	⁷⁰⁰	35 Napoleon.	10. Ham. & 11. O. Sh. ⁶⁸⁸	
229 Cincinnati. ⁵²	4 b. "	⁵⁰⁷	52 Defiance.	"	⁷⁰⁰
0 Dayton.	{ 4 c. Cincin. and 5 a. b. c. d. Niag. ⁷⁸⁴		61 Emerald.	10. Hamilton.	
17 Xenia.	{ 4 c. Cincin. and 5 a. and b. Niagara.		71 Antwerp.	9. Corniferous.	⁷³⁸
			94 Ft. Wayne.	See Indiana.	

52. Ironton. The charcoal iron manufacture of Ohio is centered here.

53. Harrisburgh. Clinton limestone, white and marble-like here.

54. Dayton. Junction of Lower and Upper Silurian well shown at Soldiers' Home. Valuable quarries in Dayton stone at many points. The Clinton limestone highly fossiliferous in this region.

55. Lebanon. One of the typical localities for fossils of the Upper Cincinnati beds.

56. Independence. Valuable quarries in Berea stone. Grit especially valuable for millstones for grinding wood pulp, pearl barley, etc.

57. Peninsula. Large quarries in Berea grit.

59. Mineral Point. Valuable bed of Kittanning clay. Best fire-clay in the State.

60. Lodi. Excellent locality for Upper Waverly fossils.

61. Massillon. Lowest coal (Sharon) mined largely here.

62. The Cincinnati Glacial Dam. The survey of the terminal moraine in Ohio, made by Rev. G. F. Wright in 1882, proved that the southern boundary of the great ice-sheet crossed the Ohio River near New Richmond, twenty-two miles by the river above Cincinnati, and extended across the northern counties of Kentucky, four or five miles south of the river, recrossing the Ohio near Aurora, Indiana. Mr. Wright inferred that one effect of this glacier was to form an immense dam of ice and moraine debris, 500 to 800 feet high, which effectually closed the old channel of the Ohio for forty-nine miles by the windings of the river, and set back the water of the river and its tributaries until, as shown by Mr. I. C. White, it probably occupied the channel between the Kanawha and the Ohio Valleys, through West Virginia, now the line of the Chesapeake and Ohio Railroad. The site of Pittsburgh, Pa., was submerged to the depth of 300 feet, the remarkable terraces in the valleys of the Ohio, Allegheny, Monongahela, and other branches, for the origin of which no satisfactory explanations had before been given, being then formed, according to White and Lesley, around the shores of this great inland lake. (See Note No. 62, in West Virginia.) J. M.

Ms. | Wheeling and Lake Erie Railway.			Ms. | Wheel'g & Lake Erie Railway—Con.		
0 Toledo.	7. Waterlime.	587	133 Sippo.	{	14 a. Congl. & 14 b.
36 Fremont.	7. Waterlime.	637			Lower Coal Meas.
59 Monroeville.	11. Ohio Shale.	736	137 Massillon. ⁶¹		" 967
64 Norwalk.	13 a. & b. Waverly.		143 Navarre.	{	14 b. Con. Coal Meas.,
85 Wellington.	13 d. Wav. D'ft h'vy. ⁸⁶¹				Mercer Horizon.
100 Lodi. ⁶⁰	13 d. & e. Waverly.		154 Zoar.		" 891
121 Orrville.	13 e. Waverly.	1074	157 Valley Junction.		"

63. The Berea Grit, the most important member of the Sub-Carboniferous formation in Ohio, is quarried here on a very large scale. The Berea Shale that makes the roofs of the quarries is highly fossiliferous.

This blank space is intended for additional geological notes in pencil by the traveler.

Michigan.¹

LIST OF THE GEOLOGICAL FORMATIONS OF MICHIGAN.

PROBABLE EQUIVALENTS OF DANA.	LOCAL DESIGNATIONS.
20. Quaternary.*	20. Quaternary, Lacustrine Drift. ²
14 c. Upper Coal Measures.	14 c. Coal Measures.
14 a. Millstone Grit.	14 a. Parma Sandstone.
13 b. Upper Sub-Carboniferous.	13 b. Carboniferous Limestone.
	13 b. Michigan Salt Group.
13 a. Lower Sub-Carboniferous.	13 a. Marshall Group.
11 b. Chemung.	11. Huron Group, Chemung Shale.
11 a. Portage.	11. Huron Group, Portage Shale.
10 c. Genesee.	11. Huron Group, Black Shale.
10 b. Hamilton.	10 b. Little Traverse Group.
9 c. Corniferous and 9 b. Schoharie.	9. Corniferous Group.
7. Lower Helderberg.	7. Lower Helderberg.
6. Salina.	6. Salina Group.
5 c. Niagara.	5. Niagara Group.
5 b. Clinton.	
4 c. Cincinnati.	4 c. Cincinnati.
4 a. Trenton.	4 a. Trenton.
3. Canadian.	3 c. and 3 a. Chazy and Calciferous.
2 b. Potsdam.	2 b. Lake Superior Sandstone.
1 c. Keweenaw.	1 c. Cupriferous Rocks, Sandstones, Conglomerates and Traps.
1 b. Huronian.	1 b. Huronian.
1 a. Laurentian.	1 a. Laurentian.

Sketch of the Geology of Michigan.*

The State of Michigan is divided, geographically, into two parts by Lake Michigan and the Straits of Mackinaw, but geologically there is no such division, the upper and lower peninsula, as they are called, being, with the portion now covered by water, one uniform series of formations succeeding each other in their proper order. For the clear understanding of its geological structure we should imagine the water of the lakes removed, or the strata extending under it. The city of Cincinnati, in Ohio, stands upon a dome or ridge of upraised older strata which have been uncovered by the planing off of their higher beds, until on both sides of it the outcrop of several of the formations appear. The strata dip from this ridge towards the east and towards the west, and the line of it extends towards the common corner of Ohio, Indiana and Michigan. It bifurcates, however, before reaching that point, the east branch running up to the west end of Lake Erie, causing several islands there, and subsides in Canada near the River Thames; while the west branch passes across the northern part of Indiana and Illinois to the head of Lake Michigan, and thence northwest through Wisconsin.

On the north another ridge of still older rocks, the 1. Laurentian, extends through Canada around the north shores of Lakes Huron and Superior. It also appears in the upper peninsula. This, the oldest of the formations, is the lowest and foundation of all, the later formations resting upon it, dipping south and southwest away from the Laurentian. The whole State of Michigan, including the parts covered by the lakes, is therefore surrounded on all sides by ancient axes of elevation, which isolated her rock formations from the adjoining regions. It may be considered as one great basin, for even if the surrounding regions do not in all cases actually occupy a higher level, yet we find the strata dip from all sides towards the centre. The upper peninsula, or that portion of the State north of Lake Michigan, is bounded around the entire south shore of Lake Superior by the 2 b. Potsdam red sandstone, of which the Pictured Rocks are composed, and reposing upon it are the south-dipping Lower Silurian series in regular belts, in a general east and west course, and extending up to 5 c. Niagara limestone, which extends between Green Bay and Lake Michigan, and forms the shores of Lake Michigan and Lake Huron. The Upper Helderberg also appears on Mackinaw and other islands.

1. This chapter was prepared for this work by Prof. Alexander Winchell, LL. D., of the University of Michigan, former Director of the Geological Survey of Michigan.

2. The rocky formations of the lower peninsula are deeply and generally covered by drift. In all the western half of the State, south of Little Traverse Bay, no good characteristic exposures exist, save in Kent county and near Holland in Ottawa county. Hence in most cases our knowledge of the underlying rocks is only a matter of inference.

* Derived chiefly from Prof. A. Winchell's Geological Reports of this State.

Michigan Central Railroad.			Michigan Central Railroad—Con (Kalamazoo Division.)		
Ms.		Alt.	Ms.		Alt.
0	Detroit.		76	Jackson.	927
8	Grand Trunk Jun.		81	Trumbull's.	
10	Dearborn.		87	Parma.	986
17	Wayne.		92	Bath Mills.	
80	Ypsilanti.		96	Albion.	
88	Ann Arbor.		101	Marengo.	
48	Delhi.		108	Marshall.	
47	Dexter.		118	Ceresco.	
55	Chelsea.		115	White's.	
62	Francisco.		121	Battle Creek.	
66	Grass Lake.		126	Bedford.	
69	Leoni.		180	Augusta.	
76	Jackson.		185	Galesburg.	
			140	Comstock.	
			144	Kalamazoo.	
			149	Ostemo.	
			156	Mattawan.	
			160	Lawton.	
			162	White Oaks.	
			168	Decatur.	
			172	Glenwood.	
			179	Dowagiac.	
			185	Pokagon.	
			191	Niles.	
			197	Buchanan.	
			202	Dayton.	
			205	Galien.	
			209	Avery's.	
			211	Three Oaks.	
			218	New Buffalo.	
				(Continued in Indiana.)	
				(Grand Rapids Division.)	
			0	Jackson.	
			10	Rives Junction.	
			17	Onondaga.	
			24	Eaton Rapids.	
			35	Charlotte.	
			40	Chester.	
			46	Vermontville.	

The lake is excavated chiefly in the 6. Salina formation, Prof. James Hall estimating that two-thirds of it is from that formation. The geological strata were first laid down extending across where the lakes now are, so that eastern Wisconsin is a part of this basin. The lakes rest in troughs which have been excavated subsequently nearly along the strike or outcropping edges of some of the softer formations. In the lower peninsula, or the main portion of the State between Lake Michigan and Lake Erie, all the Michigan series above the Niagara and up to the Carboniferous appear on the surface, but all of them much thinner than in the States farther east.

To make it still more clear we might begin at the highest formation, the 14 b. Coal Measures, which extends, in an oval form, from Jackson to Saginaw Bay. This is the upper layer of rocks, and the other formations crop out in successive layers below it on all sides. The annexed Railway Guide shows their exposures on the lines of the railroads, as they have been carefully made out by Prof. Alex. Winchell. Each rocky stratum, therefore, may be considered as dish-shaped, and taken together they form a nest of dishes or basins, the highest being the coal field near the centre of the lower peninsula, and passing from this in any direction we travel successively over the outcropping edges of older and older strata.

The Lake Superior iron ore is found in the 1 b. Huronian formation, directly west of Marquette. The copper is found chiefly in a great trap-dyke, which extends for many miles along Keweenaw Point. These iron ore and copper producing mines are the richest and most productive in America.

Michigan is therefore a distinct and independent geological area. Its topmost formation is a coal basin, underlain by the Devonian formations, very much thinned out it is true, and below that the Silurian largely developed and extending out to the oldest Laurentian rocks on the north, and all this within the bounds of the State, with small portions only of this separate geological world extending into adjoining States on the west side. The whole of the peninsula is covered with drift, from one hundred to three hundred feet deep, and rock exposures are very rare.

* Drift 164 feet on Main Street and 292 in Observatory Hill contains fossil wood at depth of 60 feet.

Michigan Central Railroad.			Michigan Central Railroad.—Con.				
Ms.	(Grand Rapids Division.)—Continued.	Alt.	Ms.	(Bay City Division.)	Alt.		
50	Nashville.	13 b. Carb. l. s.	807	0 Detroit.	11 b. L. Trav.	Quarry Deposits overlying.	
55	Sheridan.	"	856	10 Norris.	11. Hu. Lac.		
62	Hastings.	"	791	14 Warren.	"		
73	Middleville.	"	717	17 Oakwood.	"		
79	Caledonia.	"	799	24 Utica.	"		
85	Hammond.	"	754	29 Yates.	"		
94	Grand Rapids.	" Ext. exposures.	605	31 Rochester.	13 a. Mars'll		
(South Haven Division.)			35 Goodison's.	"	747		
0	Kalamazoo.	11. Huron.	777	41 Orion.	"		842
8	Alamo.	"	705	44 Oxford.	13 b. Mich. St		995
14	Kendell's.	"	792	52 Metamora.	"	1058	
17	Pine Grove.	"	777	60 Lapeer.	"	1055	
18	Gobles.	"	803	61 Junction.	"	830	
22	Bloomingsdale.	"	781	64 Millville.	13 b. Carb. limestone.		
24	Beaver Lake.	"		65 Carpenter's.	"	801	
27	Columbia.	"	682	70 Columbiaville.	"	77	
29	Grand Junction.	"	678	74 Otter Lake.	13 b. Mich. Salt.	860	
31	Geneva.	"	695	80 Millington.	14 a. Parma s. s.	757	
39	South Haven.	"	583	87 Vassar.	14 c. Coal Meas.	643	
(South Bend Division.)			95 Reese.	"	629		
0	Niles.	9. Corniferous.	681	110 Bay City *	"	592	
5	Bertrand.	"	939	Lake Shore & Michigan Southern R. R.			
9	Notre Dame.	"		(Michigan Division.)			
11	South Bend.	"		0 Cleveland.	9. Corniferous.		
(Saginaw Division.)			113 Toledo.	"	"		
0	Jackson.	14 c. Cl. Mr. Mines	942	123 Sylvania.	"		
11	Rives Junction.	"		130 Ottawa Lake.*	"	683	
15	Leslie.	"	883	133 Riga.	"	692	
25	Mason.	"		135 Blissfield.	10 b. Lit. Traverse.	684	
37	Lansing.	"	852	139 Palmyra.	11. Huron.	707	
53	Laingsburg.	"	806	141 Lenawee Junc.	"	714	
65	Owosso.	"	745	145 Adrian.	"	810	
87	St. Charles.	{ 14 c. Coal Measures		155 Clayton.	"	905	
101	Saginaw City.	{ Lacustrine.	591	162 Hudson.	13 a. Marshall.	945	
103	East Saginaw.	"	591	168 Pittsford.	"	1109	
105	Carrollton.	"		172 Osseo.	"	1126	
116	Wenona.	"	589	178 Hillsdale.	" Ext. Quarries	1095	
121	Bay City.*	"	592	182 Jonesville.	"	1097	
(Mackinaw Division.)			187 Allen's.	"	"	1064	
0	Bay City.*	14 c. C Mes., Lacus	597	194 Quincy.	11. Huron.	1027	
6	Kawkawlin.	"	627	200 Coldwater.	" worked for Brick	933	
29	Standish.	"	774	215 Bronson.	"	927	
41	Wells.	"	957	218 Burr Oak.	"	896	
54	West Branch.	13 b. Carb. limestone.		224 Sturgis.	"	934	
67	St. Helenas.	" (?)	1158	229 Douglas.	"		
78	Rosecommon.	" (?)	1128	236 White Pigeon.	"	824	
93	Grayling.	13 b. Mich. Salt.	1188	(Detroit Division)			
102	Forrest.	13 a. Marshall.	1226	0 Toledo.	9. Corniferous.		
113	Otsego Lake.	"		7 West Toledo.	"		
121	Gaylord	" (?)	1849	10 Alexis.	"		
				15 Vienna.	"		
				20 La Salle.	"		
				25 Monroe Junction.	" & L. Held'g.	579	

* Sunken in the limestone, and has underground communication with Lake Erie

3 Lacustrine deposits of Saginaw Valley 100 feet deep

4 The shallow salt wells here are supplied from the base of the Coal Measures

Lake Shore & Michigan Southern R. R.			Lake Shore & Michigan Southern R. R.		
Ms.	(Detroit Division.)—Con.	Alt.	Ms.	(Lansing Division.)—Con.	Alt.
25 Monroe Junc. ⁵	9. Cornifer.	Generally beneath lacustrine deposits.	83 Springport.	14 a. Parma s. s.	986
32 Newport.	"		38 Charlesworth.	14 c. Coal Meas.	916
38 Rockwood.	"		42 Eaton Rapids.	"	864
44 Trenton.	" exposu.		52 Diamondale.	"	
48 Wyandotte.	10 b. L. Trv.		59 South Lansing.	"	807
51 Ecorces.	"		60 Lansing.	"	827
57 Grand Trunk Junc.	11. Huron.		Grand Rapids & Indiana Railroad.		
62 Det. & Mil. Junc.	"		0 Cincinnati, O.	(See Indiana.)	
65 Detroit.	10 b. L. Trv.	581	143 Lima.	11. Huron.	
0 Monroe Junction.	9. Corniferous.	579	147 Sturgis.	"	934
10 Ida.	6. Salina, expos'es	632	157 Nottawa.	"	852
17 Petersburg.	9. Corniferous.	670	159 Wasepi.	"	842
20 Deerfield.	"	670	163 Mendon.	"	842
26 Wellsville.	10 b. Lit. Traverse.	690	168 Portage Lake.	"	834
29 Lewanee Junc.	11. Huron.	714	173 Vicksburg.	"	852
33 Adrian.	"	810	178 Austin.	"	863
(Jackson Division.)			185 Kalamazoo.	"	777
0 Adrian.	11. Huron.	810	194 Travis.	13 a. Marshall.	742
4 Lenawee Junc.	"	714	197 Plainwell.	"	744
8 Chase's.	"		202 Monteith.	"	825
13 Tecumseh.	"	807	203 Martin.	"	827
18 Clinton.	13 a. Marshall.	832	207 Shelby.	"	832
25 Manchester.	"	907	210 Bradley.	" (?)	751
32 Norvell.	"		213 Wayland.	13 b. Mich. Salt.	747
36 Napoleon.	{ " exposures exten-	sively quarried. ⁹⁶⁴	221 Ross.	"	777
40 Eldred.	13 b. Carb. l. s. (?)		227 Fisher.	13 b. Carb. l. s.	682
46 Jackson.	14 c. Cl. Measures		234 Grand Rapids.	"	605
(Kalamazoo Division.)			237 D. & M. Crossing.	"	
0 White Pigeon.	11. Huron.	824	244 Belmont.	"	661
4 Constantine.	"	808	248 Rockford.	"	689
12 Three Rivers.	"	805	251 Edgerton.	14 c. Parma s. s.	755
17 Moore Park.	"	842	255 Cedar Springs.	14 c. Cl. Measure.	846
20 Flowerfield.	"	864	257 Lockwood.	"	882
24 Schoolcraft.	"	884	260 Sand Lake.	"	912
30 Portage.	"	860	262 Pierson.	"	906
37 Kalamazoo.	"	777	266 Maple Hill.	"	872
43 Cooper.	13 a. Marshall.	749	268 Howard City.	"	
46 Argenta.	"	772	274 Morley.	"	887
49 Plainwell.	"	774	281 Stanwood.	"	954
52 Otsego.	"	710	290 Low. Big Rapids.	"	916
62 Allegan.	"	708	291 Up. Big Rapids.	"	
70 Hopkins.	"	703	295 Paris.	"	927
73 Hilliards.	"	710	302 Reed City.	" (?)	1027
77 Dorr.	13 b. Mich. Salt(?)	696	309 Ashton.	" (?)	1152
83 Byron Center.	"	740	314 Le Roy.	" (?)	1232
89 Grandville.	"	628	319 Tustin.	13 b. Mich. Salt(?)	1212
93 Eagle Mills.	13 b. Carb. l. s.	601	331 Clam Lake.	"	
95 Grand Rapids.	" exposures.	605	334 Linden.	13 b. Carb. l. s.	874
(Lansing Division.)			343 Mantou.	"	1142
0 Jonesville.	13 a. Mars'll expo.	1097	352 Walton.	13 a. Marshall.	1047
7 Litchfield.	"	1009	356 Fife Lake.	"	1047
14 Homer.	"	972	362 South Boardman.	"	1095
22 Albion.	13 b. Carb. l. s.	943	371 Kalkaska.	"	1022
29 Devereux.	14 a. Parma s. s.	990	375 Leetsville.	"	1050
			380 Havana.	"	

5. Extensive quarries, exposing in places the waterlime of Lower Helderberg.

Grand Rapids & Indiana Railroad— Continued.			Flint & Pere Marquette Railroad— Continued.		
Ms.		Alt.	Ms.		Alt.
384	Mancelona.	13 a. Marshall.	1118	43 New Boston.	11. Huron.
390	Cascade.	11. Huron.		51 Wayne.	" 662
394	Simons.	"		58 Plymouth.	" 747
399	Elmira.	" 1234		(D., L. & L. M. Crossing.)	
408	Boyne Falls.	10 b. Lit. Trav.(?) 712	62	Northville.	13 a. Marshall.
415	Melrose.	" 677	66	Novi.	"
424	Petoskey.	" ext. cliffs. 658	70	Wixom.	13 b. Mich. Salt.
	(Traverse City Railroad.)		76	Milford.	"
352	Walton.	13 a. Marshall. 1047	80	Highland.	13 b. Carb. limestone.
361	Kingsley.	" 736	83	Clyde.	"
364	Mayfield.	11. Huron.	91	Holly.	14 a. Parma s. s. 938
378	Traverse City.	" Lacustrine.	100	Grand Blanc.	14 c. Coal Meas. 715
	Detroit, Grand Haven & Milwaukee R. R.		108	Flint.	"
0	Detroit.	10 b. Lit. Traverse. 581	115	Mount Morris.	"
3	L. S. & M. S. Jun.	11. Huron.	119	Pine Run.	"
4	Gd. Trunk Jun.	" 586	123	County Line.	"
13	Royal Oak.	" 663	125	Birch Run.	"
18	Birmingham.	13 a. Marshall. 779	134	Bridgeport.	"
26	Pontiac.	" 934	138	S. & M. C. Jun.	"
31	Drayton Plains.	13 b. Mich. Salt. 967	142	E. Saginaw. ⁶	"
33	Waterford.	13 b. Carb. l. s. 988	142	E. Saginaw.	{ 14 c. Cl. Mrs. buried 100 ft. ben. Lacus. dp.
35	Clarkston.	" 1008		(J., L. & S. Crossing.)	
41	Davisburg.	" 959	152	Freeland.	14 c. Cl. Mes.
47	Holly.	14 a. Parma s. s. 938	162	Midland.	"
50	Fenton.	14 c. Coal Meas. 909	167	Averill.	"
55	Linden.	" 874	169	Sanford.	"
63	Gaines.	" 859	175	North Bradley.	"
70	Vernon.	" 770	181	Coleman.	"
75	Corunna.	" Mines. 776	186	Loomis.	"
78	Owosso.	" 745	191	Clare.	"
88	Ovid.	" 735	196	Farwell.	"
92	Shepardsville.	" 749	200	Remick.	"
98	St. Johns.	" 767	203	Lake.	934 "
107	Fowler.	" 748	209	Chippewa.	"
112	Pewamo.	" 744	213	Sears.	"
117	Muir.	" 657	217	Ewart.	"
124	Ionia.	{ " Quarries in upper sandstone. 659	226	Hersey.	"
132	Saranac.	14 c. Coal Meas. 643	230	Reed City. 1027	" (?)
139	Lowell.	14 a. Parma s. s. 641	237	Chase.	" (?)
148	Ada.	13 b. Carb. l. s. 666	239	Summitville.	" (?)
158	Grand Rapids.	" ext. quarries. 639	241	Nirvana.	" (?)
167	Berlin.	13 b. Mich. Salt. 687	248	Baldwin. 1011	13 b. Carb. l. s.
173	Coopersville.	13 a. Marshall. 646	264	Weldon Creek.	"
180	Nunica.	" 631	272	Amber.	"
186	Spring Lake.	" 596	278	Ludington.	"
187	Ferrysburg.	11. Huron.		(Flint River Division.)	
189	Grand Haven.	{ " Remarkable Sand Dunes. 594	0	Flint.	14 c. Coal Meas. 715
	Flint & Pere Marquette Railroad.		4	Junction.	"
0	Toledo.	9. Corniferous. 579	8	Genesee.	"
25	Monroe.	" & 7. Low. Held'g.	14	Ottsville.	14 a. Parma sandstone
34	Grafton.	9. Corniferous.	19	Otter Lake.	13 b. Mich. Salt.
36	Carlton.	"	124	E. Saginaw. ⁶	14 c. Coal Meas. 1441
39	Waltz.	10 b. Little Traverse.	153	Portsmouth.	"
40	Belden.	11. Huron.	155	Bay City.	" 592

⁶ Salt wells 880 feet deep to Marshall sandstone; supplied from overlying Michigan salt group.

Rocks totally concealed beneath heavy beds of Quaternary deposits. No rock exposures. Drift 200 to 300 feet.

Detroit, Lansing & Northern R. R.			Chicago & West Michigan Railroad.		
Ms.		Alt.	Ms.	Continued.	Alt.
0 Detroit.	10 b. Lit. Traverse.	581	39 Coloma.	9. Corf. (?) Sand Dunes	
3 Gd. Trunk Junc.	11. Huron.	586	42 Watervliet.	10 b. Lit. Traverse.(?)	
13 Redford.	"	631	47 Hartford.	11. Huron.	
15 Fisher's.	"	631	54 Bangor.	"	
16 Elmwood.	"	638	58 Breedsville.	"	
19 Livonia.	13 a. Mashall.	669	62 Grand Junction.	"	
23 Plymouth.	"	747	75 Rennsville.	"	678
29 Salem.	"	953	79 Richmond.	"	[fossils.
34 South Lyon.	18 b. Carb. l. s.	933	90 Holland.	13 a. Marshall, outcrops	
43 Brighton.	14 a. Parma s. s.	929	90 Holland.	13 a. Marshall.	
46 Genoa.	14 c. Coal Meas.	978	95 Zeeland.	"	
52 Howell.	"		104 Hudsonville.	"	
57 Fleming.	"	934	110 Grandville.	13 a. Michigan Salt.	
60 Fowlerville.	"	902	115 Grand Rapids.	13 b. Carb. limestone.	
65 Le Roy.	"	1232	90 Holland.	13 a. Marshall.	
71 Williamston.	outcrops.	891	99 Olive.	"	
76 Meridan.	"	850	109 Robinson.	"	
79 Okemos.	"	874	110 Nunica.	"	831
85 Lansing.	"		116 Fruitport.	"	
86 North Lansing.	"		126 Muskegon.	"	
92 Delta.	"	867	126 Muskegon.	"	894
94 Ingersoll's.	"	861	130 B. R. Junction.	"	
97 Grand Ledge.	outcrops.	880	136 Twin Lake.	"	
102 Eagle.	"	851	142 Holton.	"	
106 Danby.	"	782	150 Fremont Centre.	"	
109 Portland.	"	780	160 Allyn.	13 b. Carb. limestone.	
114 Collins.	"	777	161 Morgan.	"	
118 Lyons.	"	734	170 Traverse Road.	"	
122 Ionia.	{ " Quarries in upper sandstone.	659	181 Big Rapids.	14 c. Cl. Measure.	916
0 Ionia.	14 c. Coal Meas.	659	126 Muskegon.	13 a. Marshall.	594
5 Stanton Junc.	"	821	142 Whitehall.	"	
9 Wood's Corners.	"	831	143 Montague.	13 b. Mich. Salt.	537
14 Fenwick.	"	848	157 Shelby.	{ 13 b. Car. l. s., exten- sive deta'd tab.	508
19 Sheridan.	"	856	163 Mears.	13 b. Carb. limestone.	
24 Stanton.	"	904	170 Pentwater.	"	595
122 Ionia.	14 c. Cl. Me.	659	Grand Rapids, Newaygo & Lake Shore Railroad.		
130 Palmer's.	"	868	0 Grand Rapids.	13 b. Carb. l. s.	605
133 Chadwick.	"	856	7 Alpine.	"	609
135 Kiddville.	"	802	14 Sparta.	"	
141 Greenville.	"	819	19 Tyrone.	"	
146 Gowen.	"	848	21 Casinovia.	"	
151 Trufant's.	"	884	25 County Line.	"	
153 Maple Valley.	"	925	27 Ashland.	"	
156 Coral.	"	897	30 Grant.	"	
160 Howard.	"		36 Newaygo.	"	
Chicago & West Michigan Railroad.			39 Croton.	"	
..... Chicago.			46 Morgan.	"	
0 New Buffalo.	9. Cornif. S. Dunes.	602	67 Big Rapids.	4 c. Coal Measure.	916
7 Chickaming.	"		Detroit, Hillsdale & S. W. Railroad.		
10 Troy.	"		0 Ypsilanti.	13 a. Marshall	714
15 Bridgeman.	"		11 Saline.	"	889
16 Morris.	"		17 Bridgewater.	"	
20 Stevensville.	"		28 Manchester.	"	907
28 St. Joseph.	"		36 Brooklyn.	"	
30 Benton Harbor.	"		41 Woodstock.	"	1101

Detroit, Hillsdale & Southwestern R. R.—			Chicago & Grand Trunk Railroad.—		
Ms.	Continued.	Alt.	Ms.	Continued.	Alt.
44 Somerset.	13 a. Marshall.		84 Imlay City	13 a. Marshall.	820
49 Jerome.	"		39 Attica.	"	898
58 North Adams.	"		46 Lapeer.	13 b. Mich. salt.	820
61 Hillsdale.	" Outcrops foss.	1095	53 Elba.	13 b. Carb. l. s.	859
65 Banker's.	"	1067	57 Davison.	14 a. Parma s. s.	791
..... Reading.	11. Huron.	1200	66 Flint.	{ 14 c. Coal Measures.	
..... Camden.	"			{ Not worked.	715
Chicago & Canada Southern Railroad.			83 Durand.	{ 14 c. Coal Meas.	801
0 Fayette.	11. Huron.		87 Bancroft.	{ Some exposures,	892
7 Morenci.	"		96 Perry.	{ but not worked.	879
13 Weston.	"		100 Shaftsburg.	{ 14 c. Coal Meas.	851
17 Fairfield.	10 b. Lit. Traverse.	799	112 Trowbridge.	{ Slightly worked.	840
20 Ogden.	"		115 Lansing.	{ 14 c. Coal Measures.	
25 Blissfield.	"	684	120 Millett's.	"	
32 Deerfield.	"	670	125 Sevastopol.	"	
36 Petersburg.	"	670	127 Pottersville.	"	
40 Dundee.	9. Corniferous.	681	134 Charlotte.	"	908
42 North Rainsville.	" ext. quarries.		142 Olivet.	14 a. Parma sand s.	
47 Maybee.	"		147 Bellevue.	13 b. Car. l. s., quar. fos.	
50 Exeter.	"		152 Madison.	13 b. Michigan salt.	
55 Carlton.	"		160 Battle Creek.	{ 13 a. Marshall, out-	
57 Bryar Hill.	"			{ crop fossil.	819
61 Flat Rock.	"		170 Climax.	13 a. Marshall.	
67 Slocum Junction.	"		175 Scott's.	11. Huron.	
Toledo, Canada Southern & Detroit R. R.			179 Indian Lake.	"	
0 Detroit.	10 b. Lit. Traverse.	581	183 Vicksburg.	"	852
2 M. C. Junction.	11. Huron.		189 Schoolcraft.	"	
9 Ecorces.	10 b. Little Traverse.		200 Marcellus.	"	
12 Wyandotte.	"	580	204 Volinia.	"	
16 Trenton.	9. Corniferous.	584	209 Jamestown.	10 b. Little Traverse.	
17 Slocum Junction.	"		213 Cassopolis.	9. Corniferous.	
			222 Edwardsburg.	"	881
			(Continued in Indiana.)		
Grand Trunk Railroad.			Saginaw Valley & St. Louis Railway.		
15 Stony Creek.	{ " and 7. L. Held.		0 East Saginaw.		
	{ ext. expos. & quar.		2 Saginaw.	14 c. Coal Measures.	
20 Monroe.	6. Corn. & 7. Heldberg		6 Tittabawassee Jc	"	
25 La Salle.	9. Corniferous.		9 Swan Creek.	"	
30 Vienna.	"		11 Graham's.	"	
34 Alexis.	"		12 Sand Ridge.	"	
40 Toledo.	"		16 Hemlock.	"	
Grand Trunk Railroad.			19 Porter's.	"	
196 Port Huron.	11. Huron	633	22 West Mill.	"	
207 Smith's Creek.	"		26 Wheeler's.	"	
217 Ridgeway.	"		28 Breckenridge.	"	
223 New Haven.	"		35 St. Louis.	"	
237 Mount Clemens.	"	617	..... Elm Hall.	"	
250 Milwaukee Junc.	"	602			
255 Detroit Junction.	"		Chicago & Northwestern Railroad.		
	10 b. L. Trav.		Green Bay & Lake Superior Line.		
258 Detroit.	Drift over 100 feet deep.		0 Chicago, Ill.	(See Wisconsin.)	
Chicago & Grand Trunk Railroad.			264 Menomonee.	4 a. Trenton.	
0 Port Huron.	11. Huron.	633	273 Little River.	"	
4 Gd. Trunk Junc.	"	586	279 Wallace.	"	
10 Thornton.	"		285 Stephenson.	"	
19 Emmet.	"	779	291 Gravel Pit.	"	
27 Capac.	13 a. Marshall.	817	295 Bagley.	"	
			302 Kloman.	"	
			305 Spaulding.	3 a. Calciferous.	

Chicago & Northwestern Railroad.			Michigan & Ohio Railroad.		
Ms. Green Bay & Lake Superior Line.—Con. Alt.			Ms.	Continued.	Alt.
316 Bark River.	3 a. Calciferous.		105 Ceresco.	13 a. Marshall.	892
321 Ford River.	4 a. Trenton.		114 Battle Creek.	{ " Outcrops	
328 Escanaba.	"			{ fossils.	819
331 Flat Rock.	"		123 Augusta.	13 a. Marshall.	789
333 Bay Siding.	"		127 Yorkville.	{ " "	
337 Mason.	"	888		{ Rare exposures.	
340 Day's River.	"		129 Richland.	{ 13 a. Marshall.(?)	
345 Beaver.	"			{ No exposures.	
352 Maple Ridge.	"		145 Monteith.	13 a. Marshall.(?)	838
357 Centreville.	"	813	149 Fisk.	" (?)	
362 Helena.	3 a. Calc., 3 c. Chazy.		151 Kellogg.	" (?)	
369 Little Lake.	2 b. Lake Superior s. s.		156 Allegan.	{ 11. Huron. No con-	
370 Smith Mine Junc.	1 a. Laurentian.			{ venient exposures	708
382 Cascade Junction	1 b. Huronian.		Port Huron & Northwestern Railroad.		
384 Goose Lake.	"		(East Saginaw Division.)		
389 Negaunee.	{ 1 b. Huron, Iron		0 Port Huron.	{ 11. Huron, under	
	{ Mines.	1379		{ Lacustrine. Buried	
393 Ishpeming.	"	1443		{ trees.	
401 Marquette.	"	849	..... Gratiot Centre.	11. Huron.	813
441 L'Anse.	2 b. L. Superior s. s.	608	11 Kingsley.	"	786
Marquette, Houghton & Ontonagon R. R.			12 Saginaw Junc't'n.	"	
0 Marquette.	1 b. Huronian.	649	20 Green's Corners.	"	
3 Bancroft.	"	936	25 Brockway Centre	"	
7 Morgan.	"	1280	33 Yorks.	13 a. Marshall.	
8 Eagle Mills.	"	1379	37 Brown's City.	"	
12 Negaunee.	" Iron Mines.	1443	45 Marlette.	"	
15 Ishpeming.	" Exten. Min.	824	50 Clifford.	13 b. Mich. Salt Group	
21 Greenwood.	"	1544	59 Mayville.	13 b. Carbon. l. a.	
25 Clarksburg.	"	1535	65 Juniata.	14 a. Parma s. s.	
26 Humboldt.	"		71 D. & B. C. Junc't.	14 c. Coal Measures(?)	
35 Republic.	"	1510	72 Vassar.	" (?)	643
31 Champion.	" Iron Mines.	1597	83 Fraukemuth.	{ 14 c. Coal Measures.	
38 Michigamme.	"	1584		{ Lacustrine.	
47 Sturgeon.	1 a. Laurentian.	1643	91 East Saginaw.	{ 14 c. Coal Measures.	
56 Palmer.	1 b. Huronian.	868		{ Lacustrine, 100 feet	
63 L'Anse.	2 b. L. Super. s. s.	608		{ Many brine wells.	
93 Houghton.	{ 2-4. Eruptive rocks,		(Sand Beach Division.)		
93 Hancock.	{ with Native Copper	607	0 Port Huron.	{ 11. Huron.	
	{ Mines.		15 Grant Centre.	{ " " " "	745
Michigan & Ohio Railroad.			26 Croswell.	{ " " " "	730
0 Toledo.	{ Deep Lacustrine de-		32 Anderson.	{ " " " "	743
23 Dundee.	{ posits over 9. Cornif		45 Downing.	{ " " " "	
33 Britton.	9. Corniferous.		52 Palms.	{ " " " "	
34 Ridgeway.	11. Huron. No expos.		70 Sand Beach.	{ " " " "	
38 Tecumseh.	"	807	(Almont Division.)		
51 Cambridge.	"		0 Port Huron.	{ 11. Huron.	
60 Addison.	"		4 G. T. Junc't'n.	{ " " " "	586
67 Jerome.	"		11 Burn's.	{ " " " "	
70 Moscow.	13 a. Marshall.		16 Lamb's.	{ " " " "	
75 Hanover.	{ 13 a. Marshall, many		20 Memphis.	{ " " " "	
79 Pulaski.	{ expo., fossil casts.		26 Berville.	{ " " " "	
88 Homer.	13 a. Mar. Quarry	1114	34 Almont.	{ " " " "	
	" Expos.	1043		{ " " " "	
	13 a. Marshall.	1114		{ " " " "	
	" Old quarry	893		{ " " " "	
	{ filled.			{ " " " "	
100 Marshall.				{ " " " "	

Port Huron & Northwestern R. R.—Con.
Ms. (Port Austin Division.) Alt.

0 Port Huron.	11. Huron.
52 Palms.	"
60 Tyre.	13 a. Marshall.
70 Bad Axe.	"
77 Filion.	"
87 Port Austin.	" Salt wells.

Grand Rapids & Indiana Railroad.

425 Petosky. 688	{ 10 b. Lit. Trav. Fine
426 Bay View. 616	{ expo., many fossils.
436 Alanson.	10 b. Little Traverse.
460 Mackinaw City.	{ 9. Corniferous. Fine
	{ exposures across the
	{ Straits.

Michigan Central Railroad.
(Mackinaw Division.)

119 Gaylord.	13 a. Marshall. (?) 1349
127 Vanderbilt.	11. Huron. (?)
138 Wolverine.	" (?)
160 Mullet Lake.	10 b. Little Traverse.
166 Cheboygan.	9. Corniferous.
182 Mackinaw City.	" Outcrops.

Detroit, Mackinaw & Marquette Railroad.

0 Point St. Ignace.	{ 9. Corniferous. Fine
..... St. Ignace.	{ exposures Salina
9 Allenville.	{ Gypsum near.
11 Moran.	"
20 Palms.	5. Niagara lime.
23 Johnson.	Crossing Niag., Cin.,
27 Trout Lake.	Tren., and Calcif. forma-
37 Hendrie.	tions. Country mostly
55 Newberry.	covered by Peat, Bog, Iron
64 McMillan.	Ore, and Drift. At Au
76 Seney.	Train is outlet of a de-
84 Driggs.	pressed passage to White
91 Creighton.	Fish River and Little
101 Jerome.	Bay de Noquet.
109 Munising.	{ 2 b. L. Superior s. s.
122 Au Train.	{ Cliffs. Fine expos-
127 Rock River.	{ ures on Grand Is.
132 Deerton.	"
134 White Fish.	"
136 Sand River.	" 627
147 Chocoley.	" 617
151 Marquette.	{ 1 b. Huronian. 649
	{ Glaciated rocks.

Grand Trunk Railway.
(Michigan Air Line Branch.)

0 Ridgeway.	11. Huron.
25 D. & B. C. Cross.	13 a. Marshall.
35 Pontiac.	"
39 Orchard Lake.	"

Grand Trunk Railroad.
Ms. (Michigan Air Line Branch.)—Con. Alt.

59 South Lyon.	13 b. Mich. Salt Gr.
67 Hamburg.	14 a. Parma s. s. (?)
106 Jackson.	14 c. Coal Measures.

Michigan Central Railroad.
(South Haven Division.)

0 Kalamazoo.	11 Huron. 777
9 Alamo. 706	Whole dist. over Huron group. Only very scant outcrops. Surface level. Some scattered blocks of hard purple sandstone not identified.
15 Kendall's. 792	
18 Pine Grove. 777	
23 Bloomingdale 731	
25 Berlamont. 700	
28 Columbia	
29 Grand Junc. 678	
32 Lacota.	
40 South Haven. 588	

Chicago & Northwestern Railroad.
(Menominee River Railroad.)

0 Chicago.	5. Niagara l. s.
305 Powers.	2 b. L. Superior s. s.
313 Cedar.	"
216 Wauceda.	1 b. Huronian.
319 Sturgeon.	These roads pass through the Menominee Iron Ranges. Many outcrops of Diorites, Quartzites, and vast beds of Slates and Marbles, besides the ores of Iron which are now extensively worked.
323 Vulcan.	
..... Curry.	
326 Norway.	
..... Indiana.	
330 Quinnesec.	
334 Iron Mountain, M	
336 Lake Antoine Jo.	
339 River Siding.	
343 Spread Eagle, Ws.	
..... Commonwealth J.	
349 Florence, Wis.	These roads pass through the Menominee Iron Ranges. Many outcrops of Diorites, Quartzites, and vast beds of Slates and Marbles, besides the ores of Iron which are now extensively worked.
349 Florence, Wis.	
356 Stager, Mich.	
358 Mastodon.	
361 Panola.	
364 Crystal Falls.	
353 Brule.	
356 Stager.	
361 Armstrong.	
371 Palatka.	
373 Stambaugh, Mich	
374 Iron River.	

Toledo, Ann Arbor & Grand Trunk R. R.

0 Toledo.	{ Deep Lacustrine,
18 Monroe Junction.	{ over 9. Corniferous.
22 Dundee.	9. Corniferous.
32 Milan.	9. Cornif. Quarries nr.
40 Pittsfield.	13 a. Marshall.
46 Ann Arbor.	13 b. Mich. Salt Gp.
55 Worden's.	{ Deep (204 ft.) Drift,
61 South Lyon.	{ over 13 b. Michigan
	{ Salt Group.
	13 b. Michigan salt.
	13 b. Carbon. l. s.

Indiana.

BY PROF. JOHN COLLETT, STATE GEOLOGIST.

LIST OF THE GEOLOGICAL FORMATIONS FOUND IN INDIANA.*

20. Quaternary.*		13 b. Upper Sub-Carbonifer's.		5 c. Niagara.			
14 c. Upper Coal Measures.		13 a. Lower Sub-Carbonifer's.		5 b. Clinton.			
14 b. Middle Coal Measures.		9-12. Devonian.		4 c. Cincinnati.			
14 a. Millstone Grit and Lower Coal Measures.							
Michigan Central Railroad.			Lake Shore & Michigan Southern R. R.				
Ms.		Alt.	Ms.	(Air Line Division)—Continued.	Alt.		
0	Chicago.	(See Illinois.)	589	47	Corunna.	9-12. Devonian.	887
23	Gibson's.	5 c. Niagara.	600	50	Sedan.	"	923
29	Tolleston.	"	607	54	Waterloo.	"	897
35	Lake.	"	617	62	Butler.	"	863
44	Porter.	"	647	69	Edgerton.	"	830
50	Furnessville.	"	609	(Continued in Ohio.)			
56	New Buffalo.	"	602				
(Continued in Michigan.)			Baltimore & Ohio Railroad.				
(Joliet Division.)			(Chicago Division.)				
0	Lake.	5 c. Niagara.	617	0	Chicago.	(See Illinois.)	589
7	Ross.	"	636	34	Mich. Cen. Junc.	5 c. Niagara.	
14	Dyer.	"	635	50	L. N. A. & C. Junc.	"	
45	Joliet, Ill.	(See Illinois.)	543	58	Wellsboro.	"	
Lake Shore & Michigan Southern R. R.			72	Walkerton Junc.	9-12. Devonian.		
(Western Division.)			89	Bremen.	"		
0	Chicago.	589	106	Milford Junction.	"	841	
14	Colehour.	5 c. Niagara.	110	Syracuse.	"	870	
30	Miller's.	"	625	118	Cromwell.	"	
41	Chesterton.	"	589	128	Albion.	"	927
45	Burdick.	"		138	Avilla.	"	969
49	Otis.	"	765	143	Garrett.	"	892
51	Holmesville.	"	800	146	Auburn Junc.	"	868
59	Laporte.	9-12. Devonian.	811	147	Auburn.	"	372
66	Rolling Prairie.	"	821	163	Hicksville.	"	
73	New Carlisle.	"	772	Pittsburg, Fort Wayne & Chicago R. R.			
75	Terre Coupee.	"	760	0	Chicago.	(See Illinois.)	589
80	Warren.	"	781	16	Sheffield.	5 c. Niagara.	
86	South Bend.	"	725	20	Cassello.	"	
90	Mishawaka.	"	722	24	Clarke.	"	
96	Osceola.	"	737	31	Liverpool.	"	
101	Elkhart.	"	755	37	Wheeler.	"	666
(Air Line Division.)			44	Valparaiso.	"	738	
0	Elkhart.	9-12. Devonian.	755	53	Wanatah.	"	731
10	Goshen.	"	789	59	Hanna.	9-12. Devonian.	
18	Millersburg.	"	625	78	Donelson.	"	
25	Ligonier.	"	866	84	Plymouth.	"	1781
30	Wawaka.	"	896	95	Bourbon.	"	
34	Brimfield.	"	945	99	Etna Green.	"	
41	Kendallville.	"	974	104	Selby.	"	
				109	Warsaw.	"	824

* Four-fifths of the State of Indiana is covered with drift. It is 90 feet to the rock in Indianapolis. At some points north of Wabash River the drift has been bored into 400 to 600 feet. It thins out as you go toward Ohio River, does not reach it at some points, and is sparingly found south of that stream. (See Notes No. 62 Ohio and No. 62 West Virginia.)

Pittsburg, Fort Wayne & Chicago R. R.— Ms. Continued. Alt.			Pittsburg, Cincinnati & St. Louis R. R.— Ms. (Second Division.)—Continued. Alt.		
115 Kosciusko.	9-12. Devonian.		162 Jonesboro.	5 c. Niagara.	846
117 Pierceton.	"		169 Upland.	"	
122 Larwill.	"		175 Hartford.	"	
129 Columbia.	"	886	185 Dunkirk.	"	
140 Arcola.	"	888	189 Red Key.	"	
148 Fort Wayne. ³⁴	"	775	193 Power's.	"	
158 Maples.	"		197 Ridgeville.	"	994
(Continued in Ohio.)			200 Deerfield.	"	
Pittsburg, Cincinnati & St. Louis R. R. (First Division.)			203 Warren.	"	731
0 Indianapolis.	9-12. Devonian.	709	210 Union.	"	1108
11 Cumberland.	"		(Continued in Ohio.)		
17 Philadelphia.	"		(Columbus, Chicago & Indiana Central Division.)		
21 Greenfield.	"		0 Chicago.		589
28 Cleveland.	"		117 Logansport. ³	9-12. Devonian.	608
30 Charlottesville.	"		122 Anoka.	"	696
34 Knightstown.	"		127 Walton.	"	
35 Raysville.	"		130 Lincoln.	"	
38 Ogden's.	5 c. Niagara.		133 Galveston.	"	
39 Dunreith.	"		139 Kokomo.	"	
44 Lewisville.	"		145 Tampico.	5 c. Niagara.	
51 Dublin.	"		149 Nevada.	"	
53 Cambridge City.	"	941	152 Windfall.	"	
58 Germantown.	"		157 Curtisville.	"	
63 Centerville. ^{1 3 35}	4 c. Cincinnati.		161 Elwood.	"	858
68 Richmond. ²	"	969	166 Frankton.	"	
74 New Paris. ²	"	825	171 Florida.	"	
79 Wiley's. ²	"		175 Anderson. ²	"	880
(Continued in Ohio.)			..... Bellefontaine Crossing.		
(Second Division.)			184 Middletown.	5 c. Niagara.	
0 Chicago.		589	187 Honey Creek.	"	
20 Dalton.	5 c. Niagara.		190 Sulphur Springs.	"	
27 Lansing.	"		195 Junction.	"	
34 Shereville.	"		197 New Castle.	"	1075
41 Crown Point.	"	714	201 Ashland.	"	
47 Cassville.	"	684	204 Millville.	"	
51 Hebron.	"	714	208 Hagerstown.	"	
61 Koutt's.	"	888	215 Washington.	"	484
67 La Crosse.	9-12. Devonian.	675	..... Centreville Pike.		
77 North Judson.	"	702	224 Richmond. ³	4 c. Cincinnati.	885
91 Winamac. ³⁶	"	713	(Indianapolis & Vincennes Division.)		
97 Star City.	"	706	0 Indianapolis.	9-12. Devonian.	709
101 Rosedale.	"		4 Maywood.	"	695
105 Royal Centre.	"	735	8 Valley Mill.	"	759
111 Gebhardt.	"	762	11 West Newton.	13 a. L. Sub-Carb.	779
117 Logansport.	"	606	12 Friendswood.	"	738
121 Anoka.	9-12. Devonian.	696	16 Mooresville.	"	685
127 Onward.	"	763	18 Mathews'.	"	691
132 Bunker Hill.	"	800	20 Brooklyn.	"	659
140 North Grove.	"	817	23 Centerton. ³⁷	"	681
142 Amboy.	"	810	26 Hastings.	"	607
145 Converse.	"	815	30 Martinsville. ⁷³	"	598
148 Mier.	"	816	33 Hynds.	"	600
157 Marion.	5 c. Niagara.	811	37 Paragan.	"	577
			44 Gosport. ⁴⁷	13 b U Sub-Carb. ⁵⁹⁵	

1. Glacial markings.
2. Crowded with fossils of Lower Silurian age.
3. Rich in fossils, Devonian and Up. Silurian.

4. Pre-historic mounds.
5. Coal fossils.
6. Devonian fossils.

Pittsburg, Cincinnati & St. Louis R. R. Ms. (Indianapolis & Vincennes Div.)—Con. Alt.			Wabash, St. Louis & Pacific R. R.—Con. Ms. (L. M. & B. Division.) Alt.		
53 Spencer. ^{37 & 38}	13 b. U. Sub-Carb.	557	0 Lafayette Junc.	13 a. L. Sub-Carb.	595
62 Freedom.	"	538	8 Porter's.	"	647
65 Farmer's.	14 a. Millstone Grit.	528	10 Montmorency.	"	672
71 Worthing'n. ^{4 & 37}	{ 14 a. Mills. Gr. & 14 b.		21 Templeton.	14 b. L. Coal Meas.	675
78 Switz City. ³⁹	{ L. Coal Meas.	522	23 Oxford.	"	708
82 Lyons.	"	526	29 Boswell.	"	734
87 Marco. ⁷⁴	"	509	37 Ambia.	"	710
97 Edwardsp't. ^{5 & 37}	14 c. U. Coal Meas.	460	Cincinnati, Lafayette & Chicago R. R.		
108 Bruceville.	"	515	..... Cincinnati.		
117 Vincennes. ³⁷	"	417	..... Indianapolis.	9-12. Devonian.	709
Detroit & Eel River Railroad.			0 Lafayette.	13 a. L. Sub-Carb.	505
0 Logansport. ⁴	9-12. Devonian.		7 Porter's.	"	647
18 Denver.	"		9 Montmorency.	"	672
21 Chili.	"	725	13 Otterbien.	13 b. L. Sub-Carb.	688
27 Roann.	"	750	18 Templeton.	14 b. L. Coal Meas.	675
33 Laketon.	"	762	23 Atkinson.	"	
37 N. Manchester.	"	775	28 Fowler.	"	
45 Collamer.	"	795	35 Earl Park. ¹⁰	"	
47 South Whitley.	"	808	41 Raub.	"	
51 Taylor's.	"	864	46 Sheldon.	"	
56 Columbia City.	"	886	Indianapolis, Bloomington & Western R.R.		
62 Collin's.	"	870	0 Indiana.	9-12. Devonian.	
66 Cherubusco.	"	895	14 Brownsburg.	"	
70 Potter's.	"	881	18 Pittsboro.	13 a. Lower Sub-Carb.	
74 C. R. Crossing.	"		22 Lizton. ⁴⁴	"	
76 Cedar Creek.	"	861	27 Jamestown. ⁸⁷	"	
81 Auburn Junction.	"	868	33 New Ross.	13 b. Upper Sub-Carb.	
82 Auburn.	"	872	44 Crawfordsville. ¹¹	"	741
88 Mooresville.	"	877	54 Wayneto'n. ^{12 & 45}	14 a. Millstone Grit	
93 Butler.	"	863	65 Veedersburg.	14 a. Mills. Gr. & 14 b. L.	
Wabash, St. Louis & Pacific Railroad. (Late Toledo, Wabash & Western R. R.)			72 Covington. ^{13 & 39}	14 c. " Coal Meas.	
0 Toledo.	9-12. Devonian.		85 Danville, Ill. ¹³	14 c. "	
88 New Haven.	"	753	(Continued in Illinois.)		
94 Fort Wayne.	5 c. Niagara.	775	Cleveland, Columbus, Cincinnati & Indianapolis Railroad. (Indianapolis Division.)		
109 Roanoke.	"		0 Indianapolis.	9-12. Devonian.	709
118 Huntington.	"	724	9 Lawrence.	"	872
131 Lagro.	{ 41	698	14 Oakland.	"	848
136 Wabash. ⁷	{ 42	740	16 McCord's.	"	854
150 Peru. ⁸	"	655	21 Fortville.	"	857
157 Waverly.	"		28 Pendleton. ^{14 & 48}	"	847
166 Logansport. ⁸	{ 9-12. Devonian, 10 b.		35 Anderson. ⁴⁷	5 c. Niagara.	880
180 Rockfield.	{ Hamilton.	606	41 Chesterfield.	"	907
186 Delphi. ⁹	"		43 Daleville.	"	910
195 Buck Creek.	"		48 Yorktown.	"	924
208 Lafayette.	13 a. L. Sub-Carb.	597	54 Muncie.	"	948
213 West Point.	"		60 Selma.	"	1005
225 Attica. ⁴¹	14 a. Mills. Grit.	540	67 Farmland.	"	1037
238 West Lebanon.	"	720	75 Winchester.	"	1089
242 State Line.	14 c. Mid. Coal Meas.		84 Union.	"	1108
(Continued in Illinois.)			(Continued in Ohio.)		

7. Upper Silurian cephalopodes.
8. Upper Silurian and Devonian fossils.
9. Pentamerous and black slate.
10. Drift and knolls.

11. Keokuk crinoids.
12. Glacial markings.
13. Coal measures fossils.
14. Devonian fossils.

Indianapolis & St. Louis Railroad.			Cincinnati, Hamilton & Indianapolis R. R.		
Ms.		Alt.	Ms.	Continued.	Alt.
0 Indianapolis.	9-12. Devonian.	709	76 Glenwood.	5 c. Niagara.	
2 Asylum.	"		84 Rushville.	"	972
6 Sunnyside.	13 a. Lower Sub-Carb.		91 Arlington.		
8 Spray.	"		98 Morristown.	9-12. Dev. 9 c. Cor.	842
12 Avon.	"		108 Fountaintown.	"	
16 Easton.	"		123 Indianapolis.	"	709
19 Danville.	"	613	Indianapolis, Cincinnati & Lafayette R. R.		
23 Hadley.	"		0 Cincinnati.	(See Ohio.)	
27 Reno.	"		18 Valley Junction.	"	
31 Malta.	13 b. Upper Sub-Carb.		20 Elizabethtown.	"	646
32 Darwin.	"		25 Lawrenceburg.	4 c. Cincinnati.	479
38 Greencastle.	{ 13 b. U. Sub-Carb. & 14 a. Mills. Grit.		26 Newton. ¹⁸	"	
44 Fern.	"		33 Guilford.	"	808
48 Lena.	14 a. Millstone Grit.		34 Hansell's.	"	
53 Carbon.	14 b. Low. Coal Meas.		40 Harman's. ¹⁸	"	747
56 Perth.	"		42 Weisburg.	"	929
61 Fountain.	"		46 Sunman's.	"	1015
64 Grant.	14 c. Mid. Coal Meas.		48 Spades. ²¹	5 c. Niagara.	1013
67 Markle.	"		51 Morris.	"	982
69 Gravel Pit.	"	879	54 Batesville.	"	968
72 Terre Haute.	"	498	60 New Point.	"	
St. Louis, Vandalia, Terre Haute & Indianapolis Railroad.			62 Smith's Crossing.	"	1008
0 Indianapolis.	9-12. Devonian.	709	65 McCoy's.	"	1027
4 Fairview.	"		68 Greensburg.	"	942
9 Bridgeport.	13 a. L. Sub-Carb.	748	74 Adams.	"	880
14 Plainfield.	"	742	78 St. Paul. ¹⁷	"	852
17 Cartersburg.	"		81 Waldron. ¹⁷	"	819
19 Belleville.	"		84 Prescott.	"	
20 Clayton.	"	859	88 Shelbyville.	9-12 Devonian.	769
25 Amo.	"	820	95 Fairland.	"	774
28 Coatsville.	"	878	99 London.	"	775
33 Fillmore.	13 b. U. Sub-Carb.	844	100 Brookfield.	"	
39 Greencastle. ^{18 & 48}	13 b. & 14 a. Mills. Gt.	834	102 Acton.	"	792
43 Hamrick's.	14 a. Mills. Grit.	703	106 Gallaudet. ¹⁹	"	852
47 Reelsville.	"	628	115 Indianapolis.	"	709
50 Eagle's.	"		125 Augusta.	13 b. Up. Sub-Carbon.	
53 Harmony.	14 b. L. Coal Meas.	872	130 Zionsville.	"	
54 Knightsville. ^{18 & 49}	"		135 Whitestown.	"	
57 Brazil. ^{18 & 49}	"	643	138 Holmes.	"	800
60 Williams.	14 c. M. Coal Meas.	666	143 Lebanon.	"	925
62 Staunton.	"	643	148 Hazelrigg.	"	
65 Seeleyville.	"	585	152 Thorntown.	"	813
73 Terre Haute.	"	492	157 Colfax.	"	825
Cincinnati, Hamilton & Indianapolis R. R.			163 Clark's Hill.	"	782
0 Cincinnati.	(See Ohio.)		166 Stockwell.	"	
25 Hamilton.	4 c. Cincinnati.		171 Culver's.	"	
32 McGonigle's.	"		179 Lafayette.	"	595
39 Oxford.	"	703	Jefferson, Madison & Indianapolis R. R.		
44 College Corner.	"		0 Indianapolis.	9-12 Devonian.	723
52 Liberty.	"	979	7 Southport.	"	761
58 Brownsville.	"	793	11 Greenwood.	"	855
66 Connersville.	5 c. Niagara.	832	13 Worthsville.	"	
			15 Whiteland.	"	805
			20 Franklin. ²⁰	"	732

15. Good fossils.

16. Block coal.

17. Rich in Upper Silurian fossils; good quarries.

18. Lower Silurian fossils.

19. Healthy summit

20. Collette Glacial River bed.

21. Lower Silurian fossils.

22. Geodes.

Jefferson, Madison & Indianapolis R. R.—			Ohio & Mississippi Railroad—		
Ms.	Continued.	Alt.	Ms.	Continued.	Alt.
25 Amity.	9-12. Devonian.	693	165 Montgomery's. ⁵⁷	14 b. L. Coal Mrs.	
31 Edinburg.	13 a. L. Sub-Carb.	674	173 Washington. ⁵⁷	14 c. Mid. Cl. Mrs.	484
35 Taylorsville.	"	656	180 Wheatland. ⁷⁸	"	
38 Lowell.	"	636	185 Richland.	"	
41 Columbus.	"	630	191 Vincennes. ⁵⁸	14 d. Up. Coal Mrs.	
46 Walesboro.	"	613	(Continued in Illinois.)		
48 Waynesville	"	607	Fort Wayne & Jackson Railroad.		
52 Jonesville.	"	594	(L. S. & M. S.)		
57 Rockford. ⁵²	"	585	0 Fort Wayne.	9-12. Devonian.	762
59 Seymour.	"	605	16 New Era.	"	839
64 Chestn't R'ge	"	553	23 Auburn.	"	872
66 Langdon's.	9-12. Devonian.	539	28 Waterloo.	"	914
69 Retreat.	"	540	33 Summit.	"	1001
71 Crothers'v'le.	"	562	37 Pleasant Lake.	"	975
75 Austin.	"	549	42 Angola.	"	1052
77 Marshfield.	"	543	50 Fremont.	"	1055
82 Vienna.	13 a. L. Sub-Carb.	566	54 State Line.	"	
89 Henryville.	9-12. Devonian.	479	(Continued in Michigan.)		
93 Memphis. ⁵⁰	"	490	Ohio & Mississippi Railroad.		
100 Sellersburg.	"	478	0 Cincinnati.	(See Ohio.)	
108 Jeffersonv'le	"	455	26 Lawrenceburg.	4 c. Cincinnati.	479
Ohio & Mississippi Railroad.			24 Aurora. ⁷⁶	"	493
0 Cincinnati.	(See Ohio.)		26 Cochran.	"	493
26 Lawrenceburg.	4 c. Cincinnati.	479	33 Dillsboro.	"	
24 Aurora. ⁷⁶	"	493	37 Cold Springs	"	
26 Cochran.	"	493	40 Moore's Hill.	"	916
33 Dillsboro.	"		42 Milan.	"	985
37 Cold Springs	"		45 Pierceville.	"	1010
40 Moore's Hill.	"	916	47 Delaware.	"	
42 Milan.	"	985	52 Osgood.	5 c. Niagara.	950
45 Pierceville.	"	1010	56 Poston.	"	
47 Delaware.	"		58 Holton.	"	
52 Osgood.	5 c. Niagara.	950	62 Nebraska.	"	
56 Poston.	"		66 Butlerville.	"	
58 Holton.	"		78 North Vernon. ⁵⁴	9-12. Devonian.	727
62 Nebraska.	"		79 Hardenburg.	"	
66 Butlerville.	"		83 Fleming's.	"	
78 North Vernon. ⁵⁴	9-12. Devonian.	727	87 Seymour.	"	605
79 Hardenburg.	"		92 Shields' Mill.	13 a. L. Sub-Carbon.	
83 Fleming's.	"		98 Brownstown. ⁷⁷	"	
87 Seymour.	"	605	101 Velonia.	"	
92 Shields' Mill.	13 a. L. Sub-Carbon.		106 Medora.	"	
98 Brownstown. ⁷⁷	"		111 Sparksville.	"	
101 Velonia.	"		114 Ft. Ritner. ^{22 & 55}	"	
106 Medora.	"		117 Tunnelton. ⁵⁴	13 a. and 13 b.	
111 Sparksville.	"		121 Scotville.	13 b. Up. Sub-Carbon.	
114 Ft. Ritner. ^{22 & 55}	"		127 Mitchell.	"	676
117 Tunnelton. ⁵⁴	13 a. and 13 b.		133 Georgia.	"	
121 Scotville.	13 b. Up. Sub-Carbon.		139 Huron. ^{23 & 56}	13 b. & 14 a. Mills. Gt.	
127 Mitchell.	"	676	150 Shoals. ²⁴	14 a. & 14 b. L.C.Mr. ⁴⁸⁰	
133 Georgia.	"		158 Loogootee.	14 b. L. Coal Mrs.	532
139 Huron. ^{23 & 56}	13 b. & 14 a. Mills. Gt.		162 Clark's. ⁵⁷	"	
150 Shoals. ²⁴	14 a. & 14 b. L.C.Mr. ⁴⁸⁰		Grand Rapids & Indiana Railroad.		
158 Loogootee.	14 b. L. Coal Mrs.	532	275 Sturgis.	(See Michigan.)	
162 Clark's. ⁵⁷	"		286 La Grange.	9-12. Devonian.	915
Ohio & Mississippi Railroad.			290 Valentine.	"	952
0 Cincinnati.	(See Ohio.)		295 Wolcottville.	"	938
26 Lawrenceburg.	4 c. Cincinnati.	479	297 Rome City.	"	920
24 Aurora. ⁷⁶	"	493	304 Kendallville.	"	974
26 Cochran.	"	493	310 Avilla.	"	969
33 Dillsboro.	"		314 La Otto.	"	
37 Cold Springs	"		320 Huntertown.	"	827
40 Moore's Hill.	"	916	333 Fort Wayne.	"	752
42 Milan.	"	985	Cincinnati, Richmond & Fort Wayne Railroad.		
45 Pierceville.	"	1010	333 Fort Wayne.	9-12. Devonian.	
47 Delaware.	"		338 Adams.	5 c. Niagara.	796
52 Osgood.	5 c. Niagara.	950	354 Decatur.	"	807
56 Poston.	"		360 Monroe.	"	
58 Holton.	"		366 Berne.	"	
62 Nebraska.	"		370 Geneva.	"	
66 Butlerville.	"		374 Briant.	"	
78 North Vernon. ⁵⁴	9-12. Devonian.	727	381 Portland.	"	904
79 Hardenburg.	"		392 Ridgeville.	"	993
83 Fleming's.	"		400 Winchester.	"	1088
87 Seymour.	"	605	406 Snow Hill.	"	
92 Shields' Mill.	13 a. L. Sub-Carbon.		409 Lynn.	"	1174
98 Brownstown. ⁷⁷	"		416 Newport.	"	
101 Velonia.	"		418 Haley.	"	
106 Medora.	"		422 Parry.	"	
111 Sparksville.	"		424 Richmond.	4 c. Cincinnati.	969
114 Ft. Ritner. ^{22 & 55}	"		(Continued in Ohio, Cinn. Rich. & Ch. R.R.)		
117 Tunnelton. ⁵⁴	13 a. and 13 b.				
121 Scotville.	13 b. Up. Sub-Carbon.				
127 Mitchell.	"	676			
133 Georgia.	"				
139 Huron. ^{23 & 56}	13 b. & 14 a. Mills. Gt.				
150 Shoals. ²⁴	14 a. & 14 b. L.C.Mr. ⁴⁸⁰				
158 Loogootee.	14 b. L. Coal Mrs.	532			
162 Clark's. ⁵⁷	"				

23. Kaolin and caves.
24. Pentremites.

25. Glass sand.
26. Good Sub-Carbonif. fossils and Oolitic stone.

Fort Wayne, Muncie & Cincinnati R. R.			Wabash, St. Louis & Pacific Railway—		
Ms.		Alt.	Ms.	Continued.	Alt.
0	Fort Wayne.	9-12. Devonian.	775	85 Deed's.	9-12. Devonian.
3	Wabash Junc'n.	"	780	88 Birmingham.	"
7	Ferguson's.	"	806	90 Lincoln.	"
11	Sheldon.	"		93 Wagner's.	"
14	Ossian.	"	831	98 Rochester.	"
19	Eagleville.	"		102 Sturgeon.	"
24	Bluffton.	5 c. Niagara.	827	103 Tiosa.	"
35	Keystone.	"	871	105 Walnut.	"
38	Montpelier.	"	867	108 Railsback's.	"
47	Hartford.	"	895	110 Argos.	"
54	Eaton.	"		118 Plymouth.	" 769
65	Muncie.	"	948	125 Tyner.	"
71	McGowan's.	"		128 Knott's.	"
75	Springport.	"	1018	132 Walkerton.	"
78	Summit.	"	818	136 Kankakee.	" 622
80	N. C. Junction.	"		141 Stillwell.	"
83	New Castle.	"	1075	148 La Porte.	" 811
90	New Lisbon.	"	1098	155 Webbers.	5 c. Niagara.
96	Cambridge City.	"	941	161 Michigan City.	" 608
98	Milton.	4 c. Cincinnati.			
103	Beeson's.	"	875		
108	Connersville.	"	832		
Cincinnati, Wabash & Michigan R. R.			Louisville, Evansville & St. Louis R. R.		
0	Anderson Junc.	8. Orisk. & 9 c. Cor.	894	0 Princeton.	14 c. U. Coal Mrs. 483
13	Alexandria.	5 c. Niagara.	872	5 Lyle's.	"
34	Marion.	"	811	10 Mount Carmel.	(See Illinois.)
54	Wabash.	"	742	11 C. & V. Junction.	"
69	N. Manchester.	9-12. Devonian.	774	15 Brown's.	"
90	Warren.	"	731	19 Belmont.	"
103	Milford.	"	850	27 Crackle's.	"
115	Goshen.	"	789	29 Albion, Ill.	"
125	Elkhart.	"	741		
Wabash, St. Louis & Pacific Railway.			Louisville, New Albany & Chicago R. R.		
0	Indianapolis.	19-12. Devonian.	709	0 New Albany. ⁵⁹	{ 9-12. Devonian & 13
6	Malott Park.	"		6 Smith's Mills.	{ a. L. Sub-Carb. 438
11	Castleton.	"		12 Wilson's.	"
15	Fisher's.	"		18 Providence. ^{35 & 60}	13 a. Lower Sub-Carb.
17	Britton's.	"		23 Pekin.	"
22	Noblesville.	"		27 Farabee's.	"
28	Cicero.	"		30 Harriston. ^{26 & 61}	13 b. U. Sub-Carb. ⁸⁷²
31	Arcadia.	"		35 Salem. ^{26 & 61}	" 714
34	Buena Vista.	"		40 Hitchcock's.	"
40	Tipton.	5 c. Niagara.	607	45 Campbellsburg.	"
42	Jackson's.	"		47 Saltillo.	"
46	Sharpville.	"		52 Lancaster.	"
49	Fairfield.	"		56 Orleans. ^{26 & 63}	" 633
54	Kokomo.	"		61 Mitchell. ²⁶	" 678
59	Cassville.	"	684	65 Juliet.	"
61	Bennett's.	"		71 Bedford. ^{22 & 62}	" 679
63	Miami.	"		78 Salt Creek.	"
67	Bunker Hill Cr'g.	"	800	82 Guthrie. ²⁷	"
75	Peru.	"	655	85 Harrodsburg.	" 506
81	Courter.	9-12. Devonian.		89 Smithville.	" 717
83	Denver.	"		92 Clear Creek.	"
				97 Bloomington. ²⁶	" 742
				101 Wood Yard.	"

27. Geodes.

28. Cave and brook.

29. Rich in Keokuk crinoides.

30. Ferns.

Louisville, New Albany & Chicago R. R.—			Evansville & Terra Haute Railroad.		
Ms.	Continued.	Alt.	Ms.		Alt.
104 Ellettsville. ^{26, 27}	18 b. U. Sub-Carb. ⁶⁵²		0 Evansville. ²⁰	14 c. U. Coal Mrs.	²⁷⁸
109 Stinesville. ²²	"		3 Fair Ground.	"	
113 Gosport.	"	595	5 Erskine.	"	
117 Spring Cave. ²⁸	"		10 Ingle's.	"	
122 Quincy. ⁷⁹	"	749	13 Stacer's.	"	
125 Oakland.	"	846	15 St. James.	"	
128 Cloverdale.	"	782	17 Haubstadt.	"	
134 Putnamville.	"	687	20 Fort Branch. ²⁰	"	
139 Greencastle.	13 b. & 14 a. U. C. M. ⁸³⁴		24 King's.	"	
143 Maple Grove.	13 b. Up. Sub-Carbon.		27 Princeton.	"	483
148 Bainbridge.	"	936	31 Patoka.	"	
152 Carpentersville.	"		38 Hazelton.	"	
156 Ashby's.	"		40 Decker's.	"	
159 Ladoga.	"		45 Purcell's.	"	
163 Whitesville.	"	874	51 Vincennes.	"	417
170 Crawfordsville. ²⁹	"	741	57 John Smith's.	"	
175 Cherry Grove.	"		62 Emison's.	"	
180 Linden.	"		64 Busseron.	"	
184 Corwin.	"		66 Oak Town.	"	
187 Raub's.	"		68 Griswold.	"	
190 Taylor's.	"	864	70 Ehrman.	"	
198 Lafayette.	13 a. L. Sub-Carb. ⁵³³		73 Carlisle.	"	
204 Battle Ground.	"		77 Paxton's.	{ 14 c. Middle Coal	
211 Brookston.	"			Measures.	
215 Chalmers.	"	707	88 Sullivan. ²³	"	538
221 Reynolds.	{ 13 a. L. Sub-Carb.,		88 Shelburn. ²³	"	
	& 9-12. Devonian. ⁵⁹²		93 Farmersburg	"	
229 Bradford.	9-12. Devonian.		97 Hartford.	"	
237 Francesville.	"		101 Young's.	"	
244 Medarysville.	"		109 Terre Haute.	"	498
252 San Pierre.	"	689	St. Louis & Southeastern Railroad.		
260 La Crosse.	"	675	(Louisville & Nashville.)		
267 Wanatah.	5 c. Niagara.	721	..... St. Louis.	(See Illinois.)	
271 Haskell's.	"		136 Upton.	14 c. U. Coal Mrs.	269
273 Lake Huron Cros	"		142 Mount Vernon.	"	407
276 Westville.	"	789	154 Belknap.	"	456
279 Otis.	"	765	161 Evansville.	"	378
281 Beatty's.	"		(Continued in Kentucky.)		
288 Michigan City.	"	601	Chicago & Atlantic Railway.		
Chicago & Eastern Illinois Railroad.			0 Marion, O.		965
0 Terre Haute.	14 c. Mid. Cl. Meas.	492	92 Rivars, Ind.	5 c. Niagara.	847
5 Ellsworth.	"	488	96 Decatur.	"	820
11 Atherton.	"	522	101 Preble.	"	832
15 Clinton. ^{30, 31}	"	494	103 Kirtland.	"	846
20 Summit Grove.	"	520	106 Toecin.	9-12. Devonian.	849
23 Hillsdale.	"	452	109 Kingsland.	"	872
25 Highland.	"		113 Union.	"	832
28 Opedee.	"	810	118 Markle.	5 c. Niagara.	829
31 Newport. ³¹	"	494	122 Simpson.	"	827
37 Eugene. ³¹	"	507	127 Huntington.	"	761
55 Danville, Ill.	(See Illinois.)		131 Clear Creek.	9-12. Devonian.	829

31. Coal measures fossils.
 32. Caves.
 33. Roof of coal frescoed with plant remains.
 34. Ancient outlet of Lake Erie.
 35. Lower Silurian fossils and glacial marks.
 36. Beaver dams.
 37. Prehistoric mounds.
 38. *Collie amstone*.

39. Coal measures and L.
 40. Coal K. and fossils.
 41. Ancient outlet of Lake Erie.
 42. Choice lime.
 43. Sandrock quarries.
 44. Elevated plateau.
 45. Glacial marks.
 46. Coal plants; Lower Devonian fossils.

INDIANA.

Chicago & Atlantic Railway.			Chicago & Grand Trunk Railroad.		
Ms.		Alt.	Ms.		Alt.
136	West Point.	"	0	Chicago, Ill.	5 c. Niagara. 589
138	Willis.	"	8	Elsdon.	"
142	New Madison.	"	13	Sherman.	" 609
144	Bolivar.	"	19	Blue Island.	"
146	Newton.	"	23	South Lawn.	"
147	Laketon.	"	25	Thornton.	" 813
153	Harrisburgh.	"	36	Griffith's.	"
158	Akron.	"	39	Redesdale.	"
163	Hoover's.	"	45	Ainsworth.	"
168	Rochester.	"	55	Valparaiso.	" 738
174	Germany.	"	64	Haskell's.	"
178	Leiter's.	"	71	Wellsboro.	9-12. Devonian.
180	Marshland.	"	75	Kingsbury.	" 742
184	Monterey.	"	80	Stillwell.	"
187	Ora.	"	84	Fish Lake.	"
194	Aldine.	"	91	Crum's Point.	"
199	N. Judson.	"	99	Oliver's.	"
205	Mallard.	"	100	South Bend.	" 788
206	Wilder's.	"	104	Mishawaka.	" 722
214	Kouts.	5 c. Niagara.	110	Granger's.	"
220	Boone Grove.	"			
222	Hulburt's.	"			
226	Palmer.	"			
229	Winfield.	"			
233	Crown Point.	"			
240	Griffith.	"			
243	Highlands.	"			
245	Calumet.	"			
249	Hammond.	"			
261	Auburn, Ill.	"			
263	Englewood.	"			
264	51st Street.	"			
268	Archer Avenue.	"			
269	Chicago.	" 589			
Bedford & Bloomfield Railroad.			Indiana, Bloomington & Western R. R.		
0	Bedford.	13 b. L. Carb l. s. 679	0	Indianapolis.	9-12. Devonian. 709
7	Avoca.	"	2	Mass. Avenue.	"
12	Springville.	"	4	Belt Road.	" 723
20	Owensburg.	"	9	Hunter's.	"
22	Dresden.	14 a. L. Coal Meas.	14	Mount Comfort.	" 870
24	Robinson's.	"	18	Mohawk.	"
26	Koline.	"	22	Maxwell.	" 920
28	Rockwood.	"	26	Willow Branch.	" 950
30	Mineral City.	{ 14 b. Middle Coal Measure.	31	Wilkinson.	"
35	Bloomfield.	"	36	Kennard.	" 1037
41	Switz City.	" 526	41	Nixon.	" 1015
			44	New Castle.	4 c. Cincinnati. 1073
			49	Messick.	4 c. Cincinnati. 1090
			52	Moorland.	"
			56	Losantville.	" 1140
			60	Modoc.	"
			66	Bloomingsport.	" 1225
			71	Lynn.	" 1174
			75	Arba.	"
			79	Hollandsburg.	"
			84	Clark's.	"
			87	P. C. & St. L. Crossing.	"
47.	Large perfect earthworks and mounds.		61.	St. Louis limestone; very rich in fossils.	
48.	St. Louis fossils plants, also Keokuk.		62.	Choice oolitic limestone quarries.	
49.	Block coal.		63.	Hindoo stone whetstones.	
50.	Bituminous coal.		64.	Sandrock quarries.	
51.	Niagara.		65.	Good Bituminous coal.	
52.	Goniatite bed.		66.	Roof of coal rich in plants.	
54.	Devonian quarries.		67.	Black slate.	
55.	Geodes and Geodized fossils.		68.	Keokuk fossils.	
56.	Kaolin.		69.	Wyandotte and other caves.	
57.	Good Bituminous coal.		70.	Pentemites.	
58.	Pre-historic mounds.		71.	Rock houses.	
59.	Black slate and knobstone.		72.	Coals, K. L. and M.	
60.	Knobs and white glass sand.				

Louisville, Evansville & St. Louis R. R.			Louisville, Evansville & St. Louis R. R.		
Ms.		Alt.	Ms.	(Rockport Branch.)	Alt.
0	Louisville.		0	Centryville.	14 b. Middle Cl. Meas.
6	New Albany. ⁶⁷	13 a. L. Carb. k. s. ⁴³⁸	2	Junction.	"
12	Edwardsville. ⁶⁸	13 b. L. Carbon. l. s.	5	Bradley's.	"
15	Georgetown.	"	9	Chrisney.	"
21	Crandall.	"	10	Miller's.	" 625
27	Ramsey's.	"	12	Ritchie's.	"
34	Milltown.	"	18	Rockport.	"
39	Marengo. ⁶⁸	"	Chicago & Great Southern R. R.		
46	English. ⁶⁹	14 a. L. Coal Meas.	0	Fair Oaks.	5 c. Niagara.
53	Taswell.	"	9	Mt. Ayr.	"
56	Boston. ⁷⁰	"	19	Percy.	9-12. Devonian.
60	Birdseye. ⁷¹	14 b. Middle Cl. Meas.	22	Goodland.	{ 13 a. Lower Carbon. Knob Stone. 718
66	Kyana.	"	26	Wadena.	14 a. L. Coal Meas.
75	Huntingburg.	"	32	Orthland.	"
123	Evansville.	14 c. Up. Cl. Meas. ³⁷⁸	34	Wyndham.	"
84	Velpen. ⁷⁰	14 a. L. Coal Meas.	40	Oxford.	" 708
91	Winslow.	14 b. Middle Cl. Mers.	45	Pine Village.	" 699
99	Oakland. ⁷²	" 846	54	Attica.	" 522
105	Francisco.	14 c. U. Coal Meas.	63	Rob Roy. ⁶⁴	"
113	Princeton.	" 483	68	Stone Bluff.	14 b. Mid. Cl. Meas.
114	E. & T. H. Junc.	"	73	Veedersburg.	"
118	Lyles.	"	80	Yeddo.	"
124	Mt. Carmel.	"	Ohio & Mississippi Railroad.		
(Evansville Division.)			(Louisville Division.)		
0	Evansville. ⁸⁰	14 c. U. Cl. Meas. 378	0	North Vernon.	1-12. Devonian.
4	Smythe.	" 379	25	Lexington.	"
5	Garvin.	" 378	40	Charleston.	"
8	Stevenson.	"	53	Jeffersonville.	"
10	King's Station.	"	55	Louisville.	"
12	Chandler.	14 b. Mid Cl. Meas. ⁴⁰⁶	New York, Chicago & St. Louis Railroad.		
14	De Forrest.	" 406	(Nickel Plate Railroad.)		
17	Booneville.	" 391	0	Buffalo.	
26	Tenneson.	"	364	New Haven, Ind.	9-12. Devonian. 753
30	Pigeon.	14 b. Middle Cl. Meas.	371	Fort Wayne.	" 775
32	Centryville.	"	397	South Whitley.	" 808
33	Junction.	"	406	Packerton.	"
34	Lincoln.	"	410	Claypool.	" 902
38	Dale.	"	415	Burkett.	"
42	Ferdinand.	"	419	Mentone.	"
48	Huntingburg.	"	424	Tippecanoe.	" 868
52	Rose Bank.	14 a. L. Coal Meas.			
55	Jasper.	14 b. Mid. Coal Meas.			

73. *Martinsville.* Glacial bound'y. Glacial deposits to the north, east and west; none to the south.

74. *Edwardsport.* This road runs nearly parallel with the glacial boundary from Martinsville to Edwardsport. Glacial strata 10 miles west of Spencer, pointing southeast.

75. *Valley Junction.* Tunnel between North Bend and Valley Junction is through a glacial deposit full of finely striated stones.

76. *Aurora.* Split rock, on Woolper Creek in Kentucky, three miles below Aurora, belongs to a post glacial conglomerate, rising more than 200 feet above the river, and marks very nearly the southern boundary of the glaciated area. Gold is found in glacial deposits on Laughery's Creek, five miles southwest of Aurora. See note 62 in Ohio, and No. 62 in West Virginia.

77. *Brownstown.* The glacial boundary running nearly north by south from Charlestown to the northeast corner of Brown County, passes a little east of Brownstown.

78. *Wheatland.* The railroad re-enters the glaciated area at Wheatland.

79. *Quincy.* This railroad from New Albany to Gosport passes through an unglaciated area. The glacial boundary is about three miles south of Quincy.

80. *Fort Branch and Evansville.* From Evansville to Fort Branch the country is unglaciated, though covered with Loess. The glacial boundary runs from here nearly parallel with this road to the neighborhood of Vincennes. The above eight glacial notes are by Rev. G. F. Wright.

New York Chicago & St. Louis R. R.— (Nickel Plate Railroad.)			Terre Haute & Indianapolis Railroad. (Vandalia Line.)		
Ms.		Alt.	Ms.		Alt.
431	Argos.	"	0	Terre Haute.	13 c. U. Cl. Meas. 493
438	Hibbard.	"	6	Otter Cr'k Junc.	"
440	Burr Oak.	"	23	Rockville.	"
451	Knox.	"	31	Judson.	14 a. L. Coal Meas.
462	Thomaston.	"	38	Waveland.	9-12. Devonian.
467	Wanatah.	5 c. Niagara. 731	46	New Market.	"
477	Valparaiso.	" 733	53	Crawfordsville.	"
480	Spriggsboro.	"	61	Darlington.	13 a. L. Carb. Knob s.
484	Wheeler.	" 666	69	Colfax.	" 825
488	Hobart.	" 623	79	Frankfort.	9-12 Devonian. 841
493	Joliet Pit.	"	88	Sedalia.	"
503	Hammond.	"	98	Flora.	"
510	Cummings, Ill.	"	102	Camden.	"
512	Stony Island.	"	110	Clymer.	"
514	Grand Crossing.	"	116	Logansport.	" 606
516	Englewood.	" 604	135	Kewanna.	"
521	22d Street.	"	143	Marshland.	"
523	Chicago.	" 589	160	Plymouth.	" 731
Indiana, Bloomington & Western R. R.			173	Lakeville.	"
			183	South Bend.	" 733
Lake Erie & Western Railroad.					
0	Indianapolis.	9-12. Devonian. 709	188	Fort Recovery.	5 c. Niagara.
2	Moorfield.	" 705	149	Portland, Ind.	" 904
5	Johnsonville.	{ 13 a. L. Carb. Knob	160	Red Key.	"
		Stone.	165	Albany.	"
15	Oakley.	" 898	176	Muncie.	" 948
19	Maplewood.	" 842	176	Muncie.	" 948
23	Montclair.	" 759	192	Alexandria.	" 857
27	North Salem.	" 888	201	Ellwood.	" 858
30	Barnard.	" 902	212	Tipton.	" 868
35	Rochedale.	13 b. L. Carb. l. s. 839	225	Circleville.	9-12. Devonian.
40	Raccoon.	" 745	237	Frankfort.	" 841
45	Russellville.	" 828	246	Mulberry.	13 a. L. C. Knob s. 734
48	S. Waveland.	" 789	252	Dayton.	" 648
52	Guion.	14 a. L. Cl. Meas. 630	260	Lafayette Junc.	" 595
56	Marshall.	{ 14 b. Middle Coal	261	Lafayette.	" 595
		Measures. 700	270	Montmorency.	" 672
60	Bloomingsdale.	" 642	280	Templeton.	14 a. L. Cl. Meas. 675
67	Montezuma.	" 494	282	Oxford.	" 703
68	Hillsdale.	" 452	289	Boswell.	" 734
75	Dana.	" 643	296	Ambia, Ind.	" 710
78	Ilwaco, Ill.	"	305	Hoopeston, Ill.	" 718
81	Scotland, Ill.	"	312	East Lynn.	"
85	Chrisman.	"			

81. By the excellent Geological Map of Indiana, published by Professor Collett, with his report for 1884, the following appears to be the full section of the exposed strata of the State, with the thickness of each:

FORMATIONS.	THICKNESS IN FT.	FORMATIONS.	THICKNESS IN FT.
20 c. Alluvium.	0-50	9-12 Devonian.	
20 b. Loess.	0-30	Genesee Black Slate.	60-120
20 a. Glacial Drift.	0-311	Corniferous.	5-70
14 c. { Permo Carboniferous or	50-196	Upper Silurian.	
Upper Coal Measures.		5 c. Niagara.	20-60
14 b. Middle Coal Measures.	600-888	5 c. Clinton.	0-10
14 a. { Lower Coal Measures, and	60-210	Lower Silurian.	
Conglomerate.		4 c. Hudson River or Cincinnati.	50-320
Sub-Carboniferous.		The sub-divisions of the Devonian are too narrow to be separately noticed in the Guide.	
13 b. Chester l. s.	0-74		
13 b. St. Louis l. s.	0-330		
13 b. Keokuk l. s.	6-106		
13 a. Knobstone s. s.	12-532		

This blank space is intended for additional geological notes in pencil by the traveler.

Illinois.¹

List of the Geological Formations on the Illinois Railroads.

18 and 19. Cretaceous or Tertiary. 14 c. Upper Coal Measures. 14 b. { Lower Coal Measures and Con- 14 a. { glomerate. 13 a. Low. Carboniferous Limestone.* 9-12. Devonian.			5 c. Niagara Group. 4 c. Cincinnati Group. 4 a. Trenton and Galena Limestone. 3 c. St. Peter's Sandstone. 3 a. Calciferous and Lower Magnesian Limestone.		
Baltimore, Pittsburg and Chicago Railroad.			Ms. Illinois Central Railroad.—Continued. Alt.		
Ms.	(B. & O.)	Alt.			
0 Chicago. ⁷⁴	5 c. Niagara.	589	215 Edgewood.	14 c. Upr. Coal Mrs. ⁷³	
12 Kingston.	"	588	280 Kinmundy.	"	528
14 South Chicago.	"	591	244 Odin.	"	
21 Edgemoor.	"		262 Central City. ³	"	494
80 Miller's.	"	625	253 Centralia.	"	
84 Mich. Cent. Jun.	"		263 Richview.	"	549
			267 Ashley.	"	
			274 Dubois.	14 b. L. Cl. Mrs.	
			280 Tamaroa.	"	
			289 Du Quoin. ⁴⁵⁹	{ 14 a & b. L. Cl. Mrs. & Conglom., 48 ms.	
			302 De Soto.	"	594
			308 Carbondale. ⁶⁹	"	
			316 Makanda.	"	
			323 Cobden. ⁵	"	
			328 Anna. ⁶	4 a. Trenton, 20 miles.	
			389 Dongola,	"	
			844 Ullin. ³³³	{ 18 & 19 Cretaceous or Tertiary 21 miles.	
			865 Cairo.	"	522
Illinois Central Railroad.			Dubuque to Cairo.		
0 Chicago. ⁷⁴	5 c. Niag. 88 ms.	589	0 Dubuque.	4 a. Trenton, 71 miles.	
14 Kensington.	"	596	2 Dunleith. ⁷	"	
24 Homewood.	"		19 Galena. ⁷	"	601
27 Matteson. ⁷⁵	"	699	26 Council Hill. ⁷	"	
84 Monee.	"	796	31 Scales Mound. ⁸	"	
40 Peotone.	"		40 Apple River.	"	
47 Manteno.	"	711	46 Warren.	"	1005
56 Kankakee. ²	"	626	49 Nora.	"	
65 Chebanse.	"		57 Lena.	"	959
69 Clifton.	"	644	70 Freeport.	"	759
81 Gilman.	"	652	74 Baileysville.	5 c. Niagara, 3 miles.	
85 Onarga.	"		82 Forreston. ⁷⁷	4 a. Trenton, 42 m. ⁹⁴¹	
98 Bulkley.	4 c. Cincinnati, 16 ms.		87 Haldane.	"	849
99 Loda.	"	777	92 Polo.	"	718
103 Paxton.	"	804	105 Dixon. ⁹	"	
105 Ludlow.	{ 14 a. & b. L. Cl. Mrs & Conglom.	821			
114 Rantoul. ⁷⁶	"				
119 Thomasboro.	"				
128 Champaign. ⁷³³	14 a. & b. L. Cl. M.	739			
187 Tolono.	"				
143 Pesotum.	"	657			
150 Tuscola.	"	674			
158 Arcola.	"	733			
173 Mattoon.	14 c. U. Cl. Mrs.				
185 Neoga.	"				
199 Effingham.	"	588			

* Consisting of the 1. Kinderhook Shale, limestone and sandstone, 2. Burlington limestone, 3. Keokuk limestone, 4. St. Louis limestone and 5. Chester limestone and sandstone.

(In many localities there are no outcrops and the formations are given only in a general way.)

1. The notes are by Prof. A. H. Worthen, State Geologist of Illinois.

2. Rich in Niagara corals.

3. Shelly limestone of Upper Coal Measures filled with fossil shells, bryozoa, &c.

4. Roof shales of coal rich in fossil plants.

5. Upper Chester shales beneath conglomerate with a few fossil shells, corals, &c.

6. Quarries of St. Louis limestone with some small shells, corals, &c.

7. A few fossils characteristic of the Galena limestone.

8. Rich fossiliferous band near the base of the Cincinnati group, and crystals of barite, pyrite and dolomite in pockets of the Galena limestone.

9. Lower Trenton or Blue limestone two miles northeast of Dixon full of characteristic fossils.

Illinois Central Railroad.			Illinois Central Railroad.—Continued.		
Ms.	Dubuque to Cairo.—Continued.	Alt.	Ms.	Springfield Division.	Alt.
117	Amboy. ⁷⁸⁸		0	Springfield.	14 c. Up. Coal Mrs. 589
125	Sublette.	4 c. Cincinnati, 8 miles.	24	Mount Pulaski.	"
138	Mendota.	4 a. Trenton, 20 miles.	44	Clinton.	" 727
141	Dimmick.	"	62	Farmer City.	"
149	La Salle. ¹⁰ 510	{ 14 a. Conglo. & 14 b. L. Coal Mrs. 8 ms.	62	Gibson.	14 a. L. Cl. Mrs. 15 ms.
158	Tonica.	"	97	Roberts.	4 b. Cincinnati, 14 ms.
169	Wenona.	14 b. L. Cl. Mrs.	111	Gilman.	5. Niagara, 5 ms. 663
180	Minonk.	"	Chicago, Burlington and Quincy Railroad.		
188	Panola.	"	0	Chicago. ⁷⁴	5 c. Niagara. 589
191	El Paso.	" 742	30	Naperville.	"
200	Hudson.	"	38	Aurora.	" 649
207	Normal.	"	48	Oswego. ¹³	4 c. Cincinnati,
209	Bloomington. ¹¹	" 523	47	Bristol.	"
227	Wapella.	"	58	Plano.	"
231	Clinton.	" 727	57	Sandwich.	4 a. Trenton, 45 miles.
240	Maroa.	14 c. U. Cl. Mrs.	61	Somonauk.	"
253	Decatur.	" 666	67	Leland.	"
258	Wheatland.	"	74	Earl.	"
263	Macon.	" 716	84	Mendota.	" 749
269	Moawequa.	"	100	Malden.	"
276	Assumption.	"	105	Princeton.	{ 14 a. Congl. and 14 b. Low. Cl. Mrs. 92 ms.
285	Pana.	" 676	112	Wyanet.	"
303	Ramsey. ¹²	" 800	118	Buda.	" 768
315	Vandalia.	"	124	Neponsett.	"
330	Patoka.	" 494	132	Kewanee. ¹⁴	"
339	Sandoval.	"	140	Galva. ⁸⁵¹	{ 14 a. Cong. and 14 b. Low. Coal Measures.
344	Central City.	" 494	148	Altona.	"
345	Centralia.	"	152	Oneida.	"
358	Cairo. ²²²	18. & 19. Creta. & Ter'y	156	Wataga.	"
Middle Division.			164	Galesburg.	" 788
0	Kankakee.	5 c. Niagara 626	179	Monmouth. ¹⁵	"
5	Otto.	No exposure.	186	Kirkwood.	"
29	Kempton Jn.	"	198	Sagetown. ¹⁶	{ 18 a. Lower Carbon's Limestone, 15 miles.
35	Griswold.	"	207	Burlington.	"
50	Pontiac.	14 a. & b. Low Cl. M. 668	164	Galesburg. ⁷⁸⁸	{ 14 a. Con. and 14 b. L. Coal Mrs. 54 ms.
71	Kankakee Jn.	"	173	Abingdon.	"
73	Minonk.	"	183	Avon.	"
83	Cullom.	No exposures.	186	Prairie City.	" 664
88	Charlotte.	"	192	Bushnell.	"
42	Chatsworth.	14 a. & b. Low Cl. M. 782	203	Macomb.	"
46	Crumpton.	"	210	Colchester. ¹⁷	"
50	Risk.	"	212	Tennessee.	"
64	Colfax.	"			
79	Barnes.	"			
85	Bloomington. ⁸⁰	14 c. U. Cl. Mrs. 523			

10. Limestone of the Upper Coal Measures full of fossils.

11. Minute shells in roof of coal seam, probably No. 3.

12. Upper Coal Measure limestone with fossil shells near Ramsey.

13. Cincinnati group, rich in fossils.

14. Fossils in roof shales of coal seam, probably coal No. 5 or 6.

15. Outcrop of Burlington limestone 2 miles north of Monmouth.

16. Burlington limestone rich in fossils.

17. Roof shales of coal rich in fossil plants, coal No. 2.

18. Burlington limestone rich in fossils.

19. Fossils abundant in roof shales of coal No. 5.

20. Fossils in roof shales of coals No. 2. and 3.

21. Fossils in roof shales of coal No. 5.

Chicago, Burlington and Quincy Railroad.			Chicago, Burlington and Quincy Railroad.		
Ms.	Continued.	Alt.	Ms.	Continued.	Alt.
Mendota and Clinton Branch.			Mendota and Clinton Branch.		
228 Plymouth.	13 a. L. Carb. l. s. 5 ms.		0 Mendota.	4 a. Trenton.	749
227 Augusta.	{ 14 a. Cong. and 14 b.		9 La Moille.	"	
242 Camp Point.	{ L. Coal Mrs. 27 ms.	740	19 Ohio.	"	
252 Fowler.	13 a. L. Carb. l. s. 13 ms.	488	26 Walnut.	"	
263 Quincy. ¹⁸	"		32 Deer Grove.	4 c. Cincinnati.	
Galesburg and Peoria Division.			45 Prophetstown.	5. Niagara.	
164 Galesburg.	14 a. L. Coal Mrs.	788	62 Fulton.	"	
169 Knoxville.	"	777	66 Clinton.	"	727
180 Maquon.	"	630	Galva and Keithsburg Branch.		
188 Yates City.	"	678	0 Galva.	13 a. Lower Coal Mrs.	
190 Elmwood. ¹⁴	"	621	14 Woodhull.	"	
209 Kickapoo.	"		37 Aledo.	"	
217 Peoria.	"	458	51 New Boston.	"	578
Galena Junction.			54 Keithsburg.	"	548
0 Galena Junction.	5. Niagara.	601	66 Oquawka.	13 a. Burlington l. s.	
6 East Batavia.	"		71 Gladstone.	"	
18 Aurora.	"	649	Burlington and Quincy Branch.		
Aurora and Streator Branch.			0 Burlington.	13 a. L. Carb. Limest.	
0 Aurora.	5. Niagara,	649	10 Lomax.	"	
6 Oswego. ¹⁸	4 c. Cincinnati.		24 Adrian.	"	
18 Yorkville.	"		32 Carthage.	"	686
23 Millington.	4 a. Trenton, 21 miles.		44 West Point.	"	
28 Sheridan.	"		58 Mendon.	"	
32 Serena.	13 a. Lower Coal Mrs.		62 Ursa.	"	
36 Wedron.	" [3 a. Calcif. in		72 Quincy. ¹⁸	"	488
40 Dayton.	" bed of river.]		Rock River Division.		
44 Ottawa.	8 a. Calcif., 2 ms.	488	0 Shabbona.	4 c. Cincinnati, 3 ms.	
60 Streator.	13 a. Low. Cl. Mrs.	620	8 Paw Paw.	4 a. Trenton.	
Buda and Rushville Branch.			16 Brooklyn.	4 c. Cincinnati, 5 ms.	
0 Buda. ⁷⁶⁸	14 b. Lower Coal Mrs.		26 Amboy.	4 a. Trenton.	738
20 Wyoming.	"		37 Harmon.	4 c. Cincinnati.	
38 Brimfield.	"		47 Rock Falls.	"	
45 Elmwood. ¹⁴	"	621	Chicago and Iowa Railroad. (C. B. & Q.)		
47 Yates City.	"	678	0 Chicago. ⁷⁴	5 c. Niagara.	589
53 Farmington.	"		39 Aurora.	"	649
64 Canton. ¹⁹	"	666	57 Hinckley.	"	746
78 Lewiston. ³⁰	"		64 Waterman.	"	
95 Vermont.	"		69 Shabbona.	4 c. Cincinnati.	
110 Rushville. ²¹	"	676	79 Steward.	"	
Aurora and Geneva Branch.			86 Rochelle.	"	807
0 Aurora.	5. Niagara.	649	89 Flag Center.	4 a. Trenton.	
9 Batavia.	"		94 King's.	"	
13 Geneva.	"		98 Holcomb.	"	
			100 Davis Junction.	"	
			118 Rockford.	"	

22. Fossil plants abundant in roof shales of coal No. 2.

23. Limestone of Upper Coal Measures full of fossils.

24. Fossils in roof shales and limestone over coal No. 5.

25. Fine outcrop of Devonian shale and limestone between these points full of fossils.

26. Niagara fossils occur sparingly at each of these points.

27. Fossils abundant in Cincinnati group.

28. Fossil plants in roof shales of coal No. 2.

29. Fossils abundant in roof shales of coal No. 3, and also in that of No. 5. In the shafts opened in this vicinity.

30. Upper Coal Measure limestone with a few fossils.

Chicago, Burlington and Quincy Railroad.			Chicago, Rock Island and Pacific Railroad.		
Ms.	—Continued.	Alt.	Ms.		Alt.
Quincy, Hannibal and Louisiana Branch.					
0 Quincy. ¹⁸	488	13 a. Low Carbon. l.s.	0 Chicago. ⁷⁴	5. Niag., 48 miles.	589
10 Fall Creek.		"	16 Blue Island.	"	
17 Hannibal. ⁵⁸		"	30 Mokena.	"	
19 Hulls.		"	40 Joliet. ²⁶ 78	"	541
36 Rockport. ⁵⁴	468	"	51 Minooka.	{ 14 a. Cong. and 14 b.	
41 Pike.		5. U. Silu. Niag. group.	61 Morris. ²³	{ L. Coal Mrs. 41 ms.	
48 Louisiana. ⁵⁵		"	71 Seneca.	"	
St. Louis and Rock Island Division.			76 Marseillies.	"	
St. Louis.	416	13 a. Low Carb. l.s.	84 Ottawa.	8 a. Cal., 9 ms.	486
East St. Louis.	418	"	94 Utica.	"	
0 Alton. ⁵⁶	470	"	99 La Salle. ²³	{ 14 b. L. Cl. Mrs. ⁵¹⁰	
20 Upper Alton.		14 a. & b. L. Coal Mrs.	100 Peru. ²³	{ and Conglomerate.	
25 Brighton.	594	"	114 Bureau.	"	468
38 Medora.		"	0 Bureau.	"	
42 Kemper.		"	13 Henry.	"	
55 Greenfield.		"	20 Sparland.	"	
67 Whitehall.		13 a. Low Carbon l.s.	28 Chillicothe.	"	
82 Winchester. ⁵⁹		"	46 Peoria. ²⁴	"	458
87 Riggston.		14 a. & b. L. Coal Mrs.	Pekin.	"	475
92 Chapin.		"	Jacksonville.	"	619
101 Arenzville.		"	114 Bureau.	14 L.C. Mrs. & Cong. ⁴⁸⁵	
111 Beardstown.		"	122 Tishilwa.	"	
115 Frederick.		"	126 Sheffield.	"	
120 Browning.		"	146 Annawan.	"	
135 Vermont.		"	152 Atkinson. ²⁰	"	
154 Bushnell.	664	"	159 Geneseo.	"	
170 Roseville.		"	170 Colona.	"	
182 Monmouth.		"	179 Moline. ²⁵	9-12. Devonian.	
203 Rio.		"	188 Rock Island. ²⁵	"	544
220 Orion.	751	"	Chicago and Alton Railroad. ⁷⁹		
227 Port Byron. ⁵⁷	5 c. Niagara.		0 Chicago. ⁷⁴	5. Niagara.	589
239 Rock Island.	9-11. Devonian.	584	26 Lemont. ²⁶ 78	"	
242 Moline.	"		33 Lockport. ²⁶ 78	"	
246 Port Byron Jun.	"		38 Joliet. ²⁶	"	541
255 Rock River Jun.	5. Niagara.		53 Wilmington. ²⁷	4 c. Cincinnati.	561
268 Erie.	"		58 Braidwood. ²⁸	{ 14 a. & 14 b. Conglo.	
278 Lyndon.	"		61 Braceville. ²⁸	{ and Lower Coal Mrs.	
280 R. I. Junction.	"		65 Gardner.	"	608
291 Sterling.	"		74 Dwight.	"	609
Sheridan and Paw Paw Branch.			82 Odell.	"	734
0 Paw Paw.	No outcrop.		92 Pontiac.	"	668
20 Sheridan Jun.	"		108 Chenoa.	"	734
51 Streator.	13 a. Low. Coal.	620			

31. Outcrop of coal No. 5. $1\frac{1}{2}$ m. west of the station with numerous fossils in the roof shales.

32. St. Louis Limestone with numerous fossils.

33. Coal Measure fossils abundant in this vicinity.

34. Outcrop of Keokuk limestone with characteristic fossils 3 miles northeast of the town.

35. Keokuk limestone $1\frac{1}{2}$ miles south of town with a few characteristic fossils.

36. Outcrop of St. Louis limestone $4\frac{1}{2}$ miles east of the station with numerous fossils.

37. St. Louis limestone in heavy outcrops on Fountain creek 3 miles west of the station, and of Chester limestone $2\frac{1}{2}$ miles southwest, both formations abounding in characteristic fossils.

38. Outcrops of Chester limestone on Prairie du Long creek $2\frac{1}{2}$ miles north of the station with numerous fossils.

39. Fossils abundant in the limestone over the coal No. 6?

40. Fossil plants in roof shales and iron concretions of coal No. 2.

41. St. Louis limestone fossils scarce, 3 miles west of the town outcrops of Hamilton and Corniferous limestone with fossils.

42. Band of ferruginous shale abounding in Upper Coal Measure fossils.

Ms. Chicago and Alton Railroad.—Cont. Alt.			Ms. Chicago and Alton Railroad.—Cont. Alt. Dwight Branch.		
111 Lexington.	14 L. C. Ms.	751	0 Chicago. ⁷⁴	5 c. Niagara.	589
119 Towanda.	"	810	74 Dwight.	14 a. & b. L. C. Mrs.	509
124 Normal.	"	828	96 Streator.	"	620
126 Bloomington. ⁸⁰	"	744	109 Wenona.	"	
146 Atlanta.	"	613	118 Varna.	"	
157 Lincoln.	14 c. Upper Coal Mrs.	892	128 Lacon.	14 a. & b. L. Coal Mrs.	
164 Broadwell. ⁶¹¹	"	642	118 Varna.	14 a. Lower Coal Mrs.	
185 Springfield. ²⁹	"	691	122 La Rose.	"	
194 Chatham.	"	687	128 Washburn.	"	
206 Virden.	"		133 Cazenovia.	"	
210 Girard.	"		137 Metamora.	"	
214 Nilwood.	"		144 Washington.	"	745
223 Carlisle. ³⁰	{ 14 a. & b. Low. Coal Mrs. & Congl. 22 ms.	662	Chicago, St. Louis and Western Railroad.		
238 Shipman.	"	694	0 Chicago. ⁷⁴	5 Niagara.	589
245 Brighton. ⁸¹	"		37 Joliet.	"	541
257 Alton. ³²	18 a. L. Carb. l. s. 2 ms. { 14 a. & b. Lower Coal Mrs. and Conglom.	470	89 Streator.	14 a. & b. L. Cl Mrs..	620
258 Upper Alton.	"		93 Reading.	"	
261 Milton.	18 a. Lower Carb. l. s.		98 Long Point.	"	
269 Mitchell.	"		108 Minonk.	14 a. Lower Coal Mrs.	
276 Venice.	"	418	124 Roanoke.	"	
280 East St. Louis.	"		126 Eureka.	"	
126 Bloomington. ⁸⁰	14 a. L. Cl. Mrs.	823	133 Washington.	"	745
149 Hopedale.	"		141 Morton.	"	
157 Delavan.	{ 14 a. & b. Low. Coal Mrs. and Conglom.		145 Groveland.	14 a. & b. L. Cl. Ms.	523
171 Mason City.	"		153 Pekin.	"	705
187 Petersburg. ³³	"	619	161 Peoria.	"	453
215 Jacksonville.	"		St. Louis and Cairo Railroad.		
242 Drake.	18 a. Lower Carb. l. s.		0 East St. Louis.	13 a. Low. Carb. l. s.	418
265 Pleasant Hill.	"		13 East Carondelet.	"	
274 Quincy Junction.	5. Niagara.	408	14 Columbia. ³⁶	"	
Jacksonville Division.			19 Attica.	"	
0 East St. Louis.	13 a. Low. Carb. l. s.	418	28 Waterloo. ³⁷	"	664
8 Venice.	"		32 Cambria.	"	
16 Edwardsville Jn.	14 a. and b.		37 Red Bud. ³⁸	"	457
28 Alton.	13 a. Low. Carb. l. s.		45 Baldwin.	"	
28 Godfrey.	14 a. and b.	635	54 Sparta. ³⁹	14 a. & b. L. C. Mrs.	549
36 Delhi.	"		75 Ava.	"	
43 Jerseyville.	"		90 Murphysboro. ⁷⁰	14 a. Low. Car. l. s.	425
48 Kane.	13 a. Lower Carb. l. s.		116 Jonesboro. ⁴¹	"	
56 Carrolton. ³⁴	"		135 Hodge's Park.	19 Tertiary.	
65 Whitehall. ³⁵	"		147 Cairo.	"	312
49 Roodhouse.	14 a. and b. L. Cl. Mrs.		Ms. Cairo, Vincennes & Chicago R. R. Alt.		
91 Jacksonville.	14 a. & b. L. Cl. Mrs.	619	0 Vincennes.		
106 Ashland.	"	626	10 St. Francisville.	14 c. Upper Coal Mrs.	
119 Petersburg.	"		25 Mount Carmel.	"	
135 Mason City.	"		41 Grayville. ⁴²	"	393
149 Delavan.	"		56 Carmi.	"	401
157 Hopedale.	14 c. Lower Coal Mrs.	823	81 Eldorado. ⁷¹	"	384
180 Bloomington. ⁸⁰	"		89 Harrisburg.	14 a. & b. L. Coal Mrs.	567
			102 Stonefort.	"	
			126 Vienna.	13 a. Low. Carbon l. s.	
			151 Mound City.	18 & 19 Creta. & Ter'y.	323
			157 Cairo.	"	322

43. Numerous fossil shells replaced with yellow pyrite occur in the roof shales of coal No. 7.
 44. Fine outcrop of Upper Silurian and Devonian strata with characteristic fossils.

Chicago & Eastern Illinois Railroad.			Chicago and Northwestern Railroad.		
Ms.		Alt.	Ms.	Rockford, Freeport and Dubuque Line.	Alt.
0	Chicago.	589	0	Chicago. ⁷⁴	5. Niagara, 86 miles. 589
20	Blue Island.	"	6	Austin.	"
34	Bloom.	695	9	Oak Park. ⁸¹	"
38	Crete.	732	25	Wheaton. ⁸²	"
52	Grant.	706	30	Junction.	"
58	Momence.	735	39	Clintonville.	717
69	St. Anne.	667	42	Elgin.	700
86	Watseka.	645	66	Marengo.	"
108	Hoopston.	735	78	Belvidere.	4 c. Cincinnati.
132	Danville. ⁴³	618	93	Rockford.	4 a. Trenton.
140	Gessie.		100	Winnebago.	"
			107	Pecatonica.	"
			121	Freeport.	759
	Grape Creek Division.			Kenosha and Rockford Line.	
0	Danville Jn.	14 a. & b. L. Cl. M. ⁸¹⁸	0	Rockford.	4 a. Trenton, 18 miles.
5	Grape Creek.	"	16	Poplar Grove.	"
22	Sidells.	"	21	Capron.	4 c. Cincinnati.
			28	Harvard Jn.	5. Niagara.
			34	Alden.	"
	Chicago and Northwestern Railroad.			(See Wisconsin.)	
	Council Bluffs and Omaha Line.			Chicago, St. Paul and Minneapolis Line.	
0	Chicago. ⁷⁴	5. Niagara. 589	77	Caledonia Jn.	4 a. Trenton. 588
6	Austin.	"	78	Caledonia.	"
9	Oak Park. ⁸¹	"	85	Roscoe.	"
25	Wheaton. ⁸²	"	90	Beloit. ⁸⁷	"
36	Geneva.	"		Sycamore Branch.	
38	St. Charles.	"	0	Cortland.	5. Niagara.
44	Blackberry.	"	5	Sycamore.	"
55	Cortland.	"		Lake Geneva Line.	
58	De Kalb.	"	0	Chicago. ⁷⁴	5 c. Niagara. 590
64	Malta.	"	39	Clintonville.	" 727
75	Rochelle.	4 c. Cincinnati. 807	55	Crystal Lake.	"
84	Ashton.	"		Crystal Lake Short Line.	
88	Franklin.	4 a. Trenton. 696	0	Chicago. ⁷⁴	5 c. Niagara.
98	Dixon. ⁸⁴	" 718	43	Crystal Lake.	"
110	Sterling. ⁸⁷	" & 5. Niagara.	50	McHenry.	"
124	Morrison.	5. Niagara.	54	Ringwood.	"
136	Fulton.	"	60	Richmond.	"
138	Clinton.	4 c. Cincinnati. 727	61	Genoa Jn.	"
	(Continued in Iowa.)		70	Lake Geneva.	"
	Chicago, St. Paul and Minneapolis Line.			Wabash, St. Louis and Pacific R. R.	
0	Chicago. ⁷⁴	5 Niagara. 589	93	Pontiac.	14 a. & b. L. Cl. Mr. ⁶⁸⁸
22	Arlington Heights. ⁸⁴	"	104	Fairbury.	"
26	Palatine.	"	126	Gibson.	"
38	Cary. ⁸⁴	"	134	Foosland.	14 c. Upper Coal Mres.
43	Crystal Lake. ⁸⁴	"	145	Mansfield.	"
51	Woodstock. ⁸⁴	"	158	Monticello.	"
63	Harvard Jn.	"	180	Lovington.	"
71	Sharon.	4 c. Cincinnati.	188	Sullivan.	" 898
78	Clinton Jn.	" 727	200	Windsor.	"
91	Janesville. ⁸⁵	"	229	Altamont.	" 616
	Milwaukee, Green Bay and Marquette Line.				
0	Chicago. ⁷⁴	5. Niagara. 589			
12	Evanston. ⁸⁶	"			
21	Highland Park.	" 827			
35	Waukegan. ⁸⁶	"			
45	State Line.	"			

⁴⁵. Fine outcrop of the Kinderhook division of the Lower Carboniferous, with characteristic fossils, and Burlington limestone capping the bluffs.

Wabash, St. Louis and Pacific R. R.			Wabash, St. Louis and Pacific R. R.		
Ms.	Continued.	Alt.	Ms.	Continued.	Alt.
Detroit, Toledo, Quincy and Keokuk Line.			Detroit, Toledo, Quincy and Keokuk Line.		
0	Streator.	14 a. & b. L. Cl. Mrs. 630	0	Toledo. (see Indiana.)	14 c. U. Cl. Mrs.
6	Manville.	"	242	State Line.	14 a. Lower Coal Mrs.
11	Cornell.	"	250	Danville.	" 618
16	Rowe.	"	262	Fairmount.	" 898
19	Chicago Jun.	"	269	Homer.	" 918
Toledo, Kansas City and St. Joseph Division.			275	Sidney.	"
0	Bluffs.	18 a. L. Sub-Carb. l. s. 418	280	Philo.	14 c. Upper Coal Mrs.
4	Naples.	" 418	286	Tolono.	"
18	Griggsville.	14 a. L. Coal Mrs. 685	308	Bement.	"
17	Maysville.	"	311	Cerro Gordo.	" 807
6	Pittsfield.	"	323	Decatur.	"
20	New Salem.	" 778	339	Illiopolis.	"
27	Hadley.	18 a. L. Carb. l. s. 752	348	Buffalo.	"
37	Kinderhook. 46	" 478	362	Springfield.	" 594
40	Hulls.	" 488	378	Berlin.	"
50	Hannibal, Mo.	" 470	385	Alexander.	14 a. Lower Coal Mrs.
Cairo, Vincennes and Chicago Line.			395	Jacksonville.	"
0	Danville. 608	14 a. Low. Coal Mrs.	413	Bluffs.	18 a. Low. Carb. l. s.
10	Georgetown.	"	426	Versailles.	18 a. Low. Carbon. l. s.
16	Ridge Farm.	" 688	436	Mount Sterling.	"
23	Chrisman.	"	446	Clayton.	" 859
30	Paris.	" 705	446	Clayton.	" 859
52	Marshall. 619	14 c. Upper Coal Mrs.	458	Labuda.	"
81	Robinson.	" 508	462	Bowen.	"
90	Flat Rock.	"	467	Denver.	"
97	Pinkstaff.	"	476	Carthage.	18 a. Low. Carbon. l. s.
102	Lawrenceville. 68	" 424	481	Elvaston.	"
108	O. & M. Jun.	" 424	488	Hamilton. 68	"
108	Beman.	"	452	Camp Point.	14 b. Lower Coal Mrs.
112	Vincennes.	"	457	Coatsburg.	"
Chicago, Kansas City and St. Joseph.			463	Fowler.	18 a. Low. Carbon. l. s.
0	Peoria. 468	14 a. & b. L. Coal Mrs.	474	Quincy.	" 749
10	Pekin.	" 478	St. Louis and Chicago Line.		
22	Manito.	"	0	St. Louis, Mo.	
27	Forest City.	" 678	3	East St. Louis.	18 a. L. Sub-C. l. s. 418
41	Havana.	" 472	6	Venice.	"
49	Bath.	"	22	Edwardsville.	14 b. Lower Coal Mrs.
59	Chandlerville.	"	38	Staunton. 65	14 c. Upper Coal Mrs.
68	Virginia.	" 608	52	Litchfield.	"
83	Jacksonville.	" 619	85	Taylorville.	" 656
Havana and Springfield Line.			105	Boody.	"
0	Springfield. 689	14 c. Upper Coal Mrs.	113	Decatur. 807	"
18	Athens.	14 b. Lower Coal Mrs.	133	Bement.	14. Coal Mrs.
22	Petersburg. 68	"	141	Monticello.	14 c. Upper Coal Mrs.
31	Oakford.	"	146	Lodge.	14. Coal Mrs.
47	Havana.	" 472	149	Galesville.	"
			154	Mansfield.	14 c. Upper Coal Mrs.
			166	Osman.	"

46. Roof shale and limestone of No. 6 coal full of fossils.

47. Another outcrop of the same.

48. Fossils in the limestone over the coal.

49. Outcrop of nearly 250 feet of Chester limestone and shale abounding in the characteristic fossils of this group.

50. Fossils in limestone and shale over coal No. 6.

51. Fossils of Upper Coal Measures abundant in shale below the mill dam and two miles east of town at the bridge on the wagon road.

52. Fossils in shale and limestone over coal No. 5.

Wabash, St. Louis and Pacific R. R.			Peoria, Decatur & Evansville Railroad.		
Ma.	St. Louis and Chicago Line.—Continued.	Alt.	Ms.	—Continued.	Alt.
162	Howard.	14 a. & b. Low Coal.	98	Bethany.	14 c. U. Coal Mrs. 688
174	Gibson.	"	103	Hampton.	" 685
182	Sibley.	"	110	Nelson.	" 687
186	Strawn.	"	120	Mattoon.	" 733
193	Forrest.	" 678	131	Janesville.	"
198	Wing.	No exposures.	144	Greenup.	" 351
209	Emington.	4 c. Cincinnati group?	157	Falmouth.	"
214	Campus.	"	174	Dundas.	"
220	Reddick.	"	181	Olney.	" 480
226	Essex.	Upper Silurian.	191	Parkersburg.	"
233	Ritchie.	"	207	Brown's.	"
239	Manhattan.	"	227	Stuartsville.	"
262	Alpine.	"	233	New Harmony.	"
269	Worth.	"	230	Poseyville.	" (?)
272	Oak Lawn.	"	248	Evansville.	14 a. & b. L. Cl. Mrs.
286	Chicago. ⁷⁴	5 c. Niagara. 589			
St. Louis and Jacksonville.			Chicago, Milwaukee and St. Paul R. R.		
52	Litchfield.	14 Coal Mrs. 484	0	Chicago. ⁷⁴	5 c. Niagara. 589
72	Girard.	14 c. Up. Coal Mrs. 687	6	Pacific Jun.	"
75	Virden.	" 691	14	Montrose.	"
88	Waverly.	14 a. & b. L. Cl. Mrs.	24	Deerfield.	"
106	Jacksonville.	" 610	32	Libertyville.	"
Jerseyville Branch.			39	Gurnee.	"
0	Springfield. ²⁹	14 c. U. Coal Mrs. 592	47	Russell.	"
13	Bates.	"	0	Chicago. ⁷⁴	5. Niagara. 589
25	Waverly.	14 a. & b. L. Cl. Mrs. 691	8	Galewood.	"
36	Palmyra.	"	19	Salt Creek.	"
50	Chesterfield.	"	24	Roselle.	" 807
59	Fidelity.	"	35	Elgin.	" 706
68	Jerseyville.	"	50	Hampshire.	"
81	Jersey Landing.	13 a. Burlington l. s.	59	Genoa.	"
85	Grafton.	5 c. Niagara.	62	Kingston.	4 c. Cincinnati.
St. Louis Coal Railroad.			74	Monroe.	4 a. Trenton.
0	Marion.	14 a. & b. L. Coal Mrs.	88	Byron.	"
3	Bainbridge.	"	Racine and S. W. Division.		
11	Fredonia.	"	0	Racine.	(See Wisconsin.)
18	Carbondale.	" 394	69	Beloit. ⁸⁷	4 a. Trenton.
23	Glenahl.	"	90	Davis.	"
27	Harrison.	"	103	Freeport.	" 759
29	Murphysboro.	" 425	111	Florence.	5. Niagara.
29	Grange Hall.	"	117	Shannon.	"
35	Vergennes.	"	124	Lanark.	"
43	Pyatts.	"	131	Mt. Carroll. ⁶⁴	4. a. Trenton.
48	Pickneyville.	" 444	142	Savanna. ⁶⁴	4 c. Cincinnati.
Peoria, Decatur & Evansville Railroad.			159	Fulton.	"
0	Peoria. ⁶⁸	14 a. & b. L. Cl. Mr. 488	166	Albany.	14 b. Niagara.
10	Pekin.	" 475	181	Port Byron. ⁶⁶	"
27	Delavan.	"	187	Hampton.	14 b. Low. Cl. Mrs. 665
37	Hartsburg.	" 613	194	Moline. ⁶⁷	"
45	Lincoln.	"	197	Rock Island. ⁶⁷	Devonian. 584
56	Mount Pulaski.	"	85	Stillman Valley.	Lower Silurian.
69	Warrensburg.	"	89	Byron.	"
78	Decatur. ⁶⁶⁶	14 c. Upper Coal Mrs.	97	Leaf River.	"
88	Hervey City.	" 707	101	Adeline.	"
96	Dalton.	" 604	117	Lanark Jn.	"
			120	Lanark.	"
			138	Savanna.	"

Cincinnati, Indianapolis, St. Louis and Chicago R. R.			Alt.	Indianapolis, Bloomington and Western Railroad.—Continued.			Alt.
0 Lafayette, Ind.			595	141 Deland.	14 a. & b. L. Coal Mrs.		
46 Sheldon, Ill.	5 c. Niagara.		708	158 Clinton.	"		737
49 Iroquois.	"			180 Lincoln.	"		613
59 St. Mary.	"			187 Burtonview.	"		
65 St. Anne.	"		659	198 Mason City.	"		
75 Kankakee.	"		626	219 Havana.	"		472
131 Chicago. ⁷⁴	"		589				
Grand Tower and Carbondale Railroad.				Illinois and St. Louis Railroad.			
0 Grand Tower. ⁴⁴	{ 9-11. Devonian, ⁵⁵² { 13 a. L. Carbon, l. s. 14 a. & b. L. C. Mr. ⁵⁵¹			1 East St. Louis. ⁴¹⁸	13 a. Low. Carbon, l. s.		
10 Sand Ridge. ⁷²				5 Centerville.	"		379
15 Mount Pleasant.				7 Pittsburgh. ⁴⁶	14 a. & b. L. Coal Mrs.		
19 Mount Carbon.			372	11 Lenz.	"		
24 Carbondale.	"		394	15 Bellville. ⁴⁷	"		479
Illinois Midland Railroad.				Indianapolis, Decatur & Springfield R. R.			
0 Terre Haute.	14 a. & b. L. C. M.	498		0 Decatur.	660	14 c. Upper Coal Mrs.	
22 Paris.	" [27 ms.	705		20 Hammond.	"		672
27 May's.	"			36 Tuscola.	14 a. & b. L. C. Mrs.	657	
31 Redmon.	14 c. Upper Coal Mrs.			42 Camargo.	"		
57 Arcola.	"	674		52 Newman.	"	641	
71 Williamsburg.	"			68 Chrisman.	14 a. & b. L. Coal Mrs.		
87 Hervey City.	"	707		76 Illiana.	"		
96 Decatur.	"	666		Wabash, Chester & Western Railroad.			
128 Waynesville.	"			0 Tamaroa.	14 a. & C. L. Coal Mrs.		
142 Armington.	"			10 Pinckneyville. ⁴⁸	"	444	
166 Morton.	"			20 Cutler.	"		
166 Morton.	"			26 Steel's Mills.	"	667	
170 Groveland.	14 a. & b. L. Coal Mrs.			31 Bremen.	13 a. Low. Carbon. l. s.		
178 Pekin.	"	475		41 Chester. ⁴⁹	"		
170 Farmdale.	"	583		Jacksonville South-Eastern Railroad.			
176 Peoria.	"	463		0 Jacksonville. ⁶¹⁹	14 a. & b. L. Coal Mrs.		
Indianapolis, Bloomington & Western R. R.				12 Franklin.	"	696	
74 Mound City.		577		18 Waverly.	"	691	
85 Danville.	14 a. & b. L. Cl. Mr.	622		25 Lowder.	"	712	
107 St. Joseph.	"			31 Virden.	691	14 c. Upper Coal Mrs.	
116 Urbana.	"			34 Girard.	"	14 c. Up. Cl. Mrs.	657
118 Champaign.	"	732		38 McVey.	"	14 Coal Mrs.	666
128 Mahomet.	"			48 Barnett.	"		672
141 Farmer City.	"			54 Litchfield.	"		464
151 Le Roy.	"			68 Sorrento.	"		
166 Bloomington.	"	823		78 Betterton.	"		
177 Danver's.	"			94 Kevesport.	"		
186 Mackinaw.	"			105 Shattuck.	"		
193 Tremont.	"			112 Centralia.	14 c. U. Cl. Mrs.	494	
202 Pekin.	"	475		Lake Shore and Michigan Southern R. R.			
211 Peoria.	"	463		0 Chicago. ⁷⁴	5 c. Niagara.	589	
116 Urbana.	"			7 Englewood.	"	604	
118 Champaign.	"	732		12 South Chicago.	"	591	
128 Mahomet.	"			Michigan Central Railroad.			
139 Monticello.	"			0 Chicago. ⁷⁴	5. Cincinnati.	589	
164 Decatur.	14 c. Up. Cl. Mrs.	666		14 Kensington.	"	596	
				35 Lake.	"	466	

53. Burlington limestone and Kinderhook group.

54. Kinderhook group with a few feet of Devonian and Upper Silurian at the base of the bluff.

55. Kinderhook, Devonian and Upper Silurian, the highest bluffs capped with Burlington limestone.

Michigan Central Railroad.—Continued.			Ms. Rock Island and Peoria Railway. Alt.		
Ms.	Joliet Division.	Alt.			
0 Lake.	5. Cincinnati.	466	0 Peoria.	463	14 a. & b. L. Coal Mrs.
15 Dyer.	"		15 Dunlap.	"	
24 Matteson.	"		22 Princeville.	"	719
32 Frankfort.	"	755	31 Wyoming.	"	
37 Spencer.	"	712	36 Toulon.	"	723
45 Joliet. ⁷⁸	5 c. Niagara.	541	42 Lafayette.	"	
Ohio and Mississippi Railroad.			48 Galva.	"	867
0 St. Louis.	(See Missouri.)	416	53 Bishop Hill.	"	
2 East St. Louis.	13 a. L. Car. l. s. 5 ms.		62 Cambridge.	"	778
10 Caseyville. ⁵⁰	14 a. & b. L. Coal Mrs.		68 Osco.	"	
18 O'Fallon.	"	545	80 Coal Valley.	"	
24 Lebanon.	"	441	86 Milan.	"	
27 Summerfield.	"		91 Rock Island.	"	9-11 Dev. 584
31 Trenton.	"	500	Pittsburg, Fort Wayne & Chicago R. R.		
39 Breese.	14 c. Upper Coal Mrs.		0 Chicago. ⁷⁴	5 c. Niagara.	
48 Carlyle.	"	450	18 Hobart.	"	
61 Sandoval.	"	494	St. Louis, Aton & Terre Haute R. R.		
65 Odin.	"	525	0 East St. Louis. ⁴¹⁸	13 a. Low. Carbon. l.s.	
70 Salem.	"	538	6 Centreville.	"	379
87 Xenia.	"		10 Ogles.	14 a. & b. L. Coal Mrs.	
96 Flora.	"	495	13 West Bellville.	"	
103 Clay City.	"		14 Bellville.	"	479
118 Olney.	"	480	22 Freeburg. ⁵⁸	"	814
130 Sumner.	"	457	29 New Athens.	"	404
139 Lawrenceville ⁵¹	"		47 Coulterville.	"	542
149 Vincennes.	"		61 Pinckneyville.	"	444
Springfield Division.			71 Du Quoin.	"	459
0 Beardstown.	14 a. & b. L. C. Mrs. ⁴³⁶		Louisville & Nashville Railroad.		
13 Virginia.	"	608	St. Louis, Evansville and Nashville Line.		
29 Pleasant Pl'ns ⁵²	"	606	0 East St. Louis. ⁴¹⁸	13 a. Low. Carbon. l.s.	
40 Bradford.	"	581	14 Bellville.	479	14 a. & b. L. Coal Mrs.
44 Coal Shaft.	14 c. Upper Coal Mrs.		0 Bellville.	"	
45 Springfield.	"	582	6 O'Fallon.	"	545
53 Rochester.	"	569	20 Rentschler's.	"	
63 Edinburg.	"		25 Mascoutah.	"	425
72 Taylorsville.	"		32 New Memphis.	"	411
88 Pana.	"		35 Venedy.	"	412
121 Altamont.	"	616	49 Nashville.	503	14 c. Upper Coal Mrs.
132 Edgewood.	"		60 Ashley.	"	549
146 Louis.	"	480	69 Woodlawn.	"	495
153 Flora.	"		87 Belle River.	"	
174 Fairfield.	"	538	100 Shawnee Jun.	"	488
181 Barnhill.	"	385	0 Shawnee Jun.	"	486
194 Enfield.	"	463	1 McLeansboro.	"	500
199 Sacramento.	"	413	13 Broughton.	"	
209 Omaha.	14 a. Low. Cl. Mrs. ³⁶⁹		22 Eldorado. ⁷³	"	384
216 Ridgeway.	"	379	30 Equality.	14 b. Lower Coal Mrs.	
225 St. L. & S. E. Jun.	"		36 Cypress Jun.	"	840
228 Shawneetown.	"	363	42 Shawneetown.	"	363

56. St. Louis limestone and Lower Coal Measures with characteristic fossils.

57. Niagara limestone with numerous fossils.

58. Coal shale $1\frac{1}{2}$ miles northeast of station full of fossil shells.

59. Limestone over No. 9 coal with fossils.

60. Upper Coal Measure limestone full of fossils.

61. Fossils in roof shales and limestone of coals No. 5 and 6.

62. Coal Measure limestone with fossil corals and shells.

Louisville & Nashville Railroad.—Con.			Lake Erie & Western Railroad.		
Ms. St. Louis, Evansville and Nashville Line. Alt.			805 Hoopstown, Ill.	14 a. L. C. M. & Cgl. ⁷¹⁸	
101 McLeansboro.	14 c. Up. Coal Mrs.	500	812 East Lynn.	"	
113 Enfield.	"	498	817 Rankin.	"	
123 Carmi.	"	401	818 Pellsville.	"	
181 Wabash.	"		827 Paxton.	4 c. Cincinnati.	
St. Louis, Vandalia & Terre Haute R. R.			841 Gibson.	14 a. L. C. Ms. & Congl.	
0 East St. Louis.	13 a. L. Carb. l. s.	418	851 Saybrook.	"	
11 Collinsville.	14 a. Low. Cl. Mrs.	465	857 Arrowsmith	"	
19 Troy.	"	539	861 Ellsworth.	"	
30 Highland. ⁵⁹	14 b. Up. Cl. Mrs.	527	864 Padua.	"	
40 Pocahontas.	"	498	867 Holder.	"	
49 Greenville.	"	555	877 Blooming. ⁸⁰	"	823
67 Vandalia.	"	500	Louisville, Evansville & St. Louis R. R.		
81 St. Elmo.	"		0 Mt. Vernon, Ind.		407
86 Altamont.	"	616	8 Blueford.	"	
98 Effingham.	"	588	20 Wayne, Ill.	14 c. Upper Coal Mrs.	
102 Teutopolis.	"		30 Fairfield.	"	538
122 Greenup.	"	351	34 Meriam.	"	
130 Casey. ⁶⁰	"		47 Albion.	"	
137 Martinsville.	"	573	51 Brown's Cross.	"	
148 Marshall. ⁶¹	"	619	56 Bellmont.	"	
151 Griffiths.	"		65 Mt. Carmel.	"	
155 Dennison.	13 a. Low. Carbon. l. s.		74 E. & T. H. Jun.	"	
158 Farrington.	"		75 Princeton.	"	483
166 Terre Haute.	"	498	88 Francisco.	"	
Toledo, Peoria & Western Railroad.			90 Oakland.	"	846
0 State Line.	5. Niagara.		Chicago and Iowa Railroad.		
2 Sheldon.	"	708	89 Flag Centre.	4 a. Trenton.	
11 Watseka. ⁶²	"	627	95 Chana.	"	
25 Gilman.	"	652	98 Honey Creek.	3 c. St. Peters s. s.	
29 La Hogue.	4 c. Cincinnati.		101 Oregon.	"	704
40 Chatsworth.	"	732	108 Mt. Morris.	4 a. Trenton. l. s.	906
47 Forrest.	"	678	114 Maryland.	"	941
52 Fairbury.	14 a. & b. L. C. Mrs.	697	120 Forrester.	"	
63 Chenoa.	"	724	132 Freeport.	"	
67 Meadows.	14 c. Up. Coal Mrs.	764	Rock Island & Mercer County Railroad.		
78 El Paso.	"	742	0 Rock Island.	9-12 Devonian.	584
92 Eureka.	"		4 Milan.	"	
99 Washington.	"	745	12 Taylor Ridge.	14 a. & b. L. Cl. Mrs.	
109 Hilton.	14 a. Lower Coal Mrs.		26 Cable.	"	
111 Peoria.	"	463	Chicago & Evanston Railroad.		
139 Canton.	"	656	0 Chicago. ⁷⁴	5 c. Niagara.	589
149 Cuba.	"	674	7 Flaxton.	"	
171 Bushnell.	"	664	10 Calvary.	"	
189 Blandinsville.	"	730	Kankakee & Seneca Railroad.		
195 La Harpe.	13 a. L. Carb. l. s.	687	0 Kankakee.	5 c. Niagara.	626
215 Burlington.	"		5 Hawkins.	"	
195 La Harpe.	"	687	11 Bonfield.	4 c. Cincinnati gr.	
200 La Crosse.	"		18 Essex.	"	
210 Ferris.	"	677	24 Gardner.	14 a. & b. L. C. Mr.	603
216 Elvaston.	"	663	31 Mazon.	"	
222 Hamilton. ⁶³	"		36 Hill Park.	"	
227 Warsaw. ⁶³	"		43 Seneca.	"	

^{63.} Fine outcrops of Keokuk limestone with numerous fossils, and geodes containing crystallized quartz, chalcedony, calcite, dolomite, arragonite, blende and pyrite.

Ms. Indianapolis & St. Louis R. R. Alt.			Central Iowa Railway.	
72 Terre Haute, Ind.			0 Peoria, ⁶⁸	14 a. & b. L. Cl. Mr. ⁴⁶³
84 Vermillion.	14. Coal Measures.		13 Hanna.	"
91 Paris.	"	705	18 Trivoli.	"
100 Dudley.	"		24 Farmington.	"
105 Kansas.	"		29 Claire.	"
118 Charleston.	"		38 London Mills.	"
129 Matoon.	"	733	43 Hermon.	"
141 Windsor.	"		49 Abingdon.	"
152 Shelbyville	"		57 Berwick.	"
168 Pana.	"		61 Phelps.	"
181 Nokomis.	"		66 Monmouth.	13 a. Low. Carb. l. s.
190 Irving.	"		73 Eleanor.	"
200 Butler.	"	757	77 Little York.	"
207 Litchfield.	"		84 Seaton.	"
217 Gillespie.	"		92 Keithsburg.	" 543
226 Bunker Hill.	"		Champaign and Havana Line.	
232 Dorseys.	"		0 Urbana.	14 a. L. Coal Mrs.
237 Bethalto.	"		2 Champaign.	" 732
242 Wann.	13 a. St. Louis l. s.		10 Seymour.	"
245 Edwardsville Cro	ssing. "		15 White Heat.	"
262 East St. Louis.	73 a. L. Carb. l. s. 418		21 Monticello.	"
265 St. Louis.	" 416		34 Argenta.	"
Danville, Olney & Ohio River R. R.			45 Decatur.	14 c. Up. Coal Mrs. 666
0 Danville Jn.	14. Coal Mrs.	610	18 Lodge.	"
31 Hume.	"	649	28 Weldon.	"
49 Kansas.	"		40 Clinton.	" 727
68 Casey.	"	649	50 Midland City.	"
89 Willow Hill.	"		52 Beason.	"
100 West Liberty.	"		56 Skelton.	14 b. Low. Coal Mrs.
109 Olney.	"		62 Lincoln.	"
Toledo, Cincinnati & St. Louis R. R.			74 New Holland.	"
272 Humerick.	14 b. Low. Cl. Mrs.		80 Mason City.	"
278 Ridge Farm.	"	615	88 Easton.	"
288 Metcalf.	"	618	93 Poplar City.	"
297 Brocton.	"		100 Havana.	"
311 Bushton.	"		Litchfield, Carrollton & Western R. R.	
332 Trilla.	"		1 Columbiana.	13 a. Low. Carbon. l. s.
349 Stewardson.	"		11 Carrollton.	"
357 Fancher.	14 c. Upper Cl. Mrs.		22 Greenfield.	14 b. Low. Coal Mrs.
370 Herrick.	"		Fulton County Narrow Gauge Railway.	
382 Boyle.	"		0 Galesburg.	758 14 a. Cg. & 14 b. L. C. M.
401 Donnellson.	"		19 London Mills.	"
407 Sorrento.	14 b. Lower Cl. Mrs.		30 Fairview.	"
418 Alhambra.	"		35 Fiatt.	"
431 Edwardsville.	"		40 Cuba.	"
450 East St. Louis.	13 a. L. Sub. Ca. l. s. 418		50 Lewiston.	"
61 Havana.	"			"
Ms. Indiana, Illinois & Southern R. R. Alt.				
0 Effingham.	14 c. Up. Coal Mrs. 588			
14 Wheeler.	"			
23 Newton.	"			
31 Willow Hill.	"			
37 Oblong.	"			
47 Robinson.	"	508		
53 Palestine.	"			

⁶⁴. Cincinnati group with characteristic fossils, and near Savanna the Niagara limestone caps the hills and affords silicified corals in abundance.

Ms. Havana, Rantoul & Eastern R. R. Alt.		Ms. Indiana, Illinois & Iowa Railroad. Alt.	
0 West Lebanon.	Indiana.	0 Streator.	14 a. & b. L. Cl. Mr. 520
12 Alvan.	14 b. Low. Coal Mrs.	6 Missal.	"
17 Henning.	"	12 Budd.	"
26 Armstrong.	"	22 Dwight.	" 509
34 Gifford.	"	29 Wilson.	"
42 Rantoul. 76 521	14 a. & b. L. C. M. & Cg.	32 Reddick.	4 c. Cincinnati Group?
45 Prospect.	14 b. Low. Coal Mrs.	37 Union Hill.	"
52 Fisher.	"	42 Goodrich.	"
56 Dickerson.	"	44 Cagwin.	5 c. Niagara.
58 Howard.	"	52 Kankakee.*	" 516
66 Delana.	"	58 Exline.	"
71 Crumbaught.	"	63 Momence.	" 525
76 Le Roy.	"	68 Castleton.	"

65. Fossils in limestones over No. 9 coal.

66. Upper Silurian limestone with numerous fossils.

67. Devonian limestone and shale with fossils.

68. Coal Measures fossils.

Glacial Notes by Rev. G. Frederick Wright.

69. Carbondale.—The Glacial boundry is between Carbondale and Mankanda. Fine Glacial strise are found $2\frac{1}{4}$ miles southwest of Carbondale and 5 miles southeast.

70. Murphysboro.—Glacial boundary about 5 miles south of Murphysboro turning thence to run parallel with the Mississippi to the neighborhood of St. Louis.

71. Eldorado.—The railroad crosses the southern boundary of the glaciated area at Eldorado and runs nearly parallel with it to Carnie. The boundary runs northeast by southwest.

72. Sand Ridge.—The western boundary of the glaciated area passes a mile or two west from Sand Ridge and runs northwest, following the course of the Mississippi River.

73. Eldorado.—The southeastern boundary of the glaciated loop of Illinois, passes through Eldorado, crossing the Wabash near New Harmony.

Glacial Notes by Prof. T. C. Chamberlin.

74. Chicago.—Subaqueous till. Lacustrine plain. Beach line. B. & O. to Michigan Central Junction, and Illinois Central to Desoto, drift plain.

75. Matteson.—Obscure moraine.

76. Rantoul.—Moraine.

77. Forreston.—Osar.

78. Joliet, Lemont, Lockport.—Ancient outlet of Lake Michigan.

79. From Wilmington to Quincy Junction, deep drift plain.

80. Bloomington.—Two vegetal beds in drift.

81. Oak Park.—Beach ridge.

82. Wheaton.—Moraine?

83. Arlington Heights.—Beach ridge.

84. Cary, Crystal Lake and Woodstock.—Moraine.

85. Janesville.—Glacial flood deposit.

86. Evanston, Highland Park and Waukegan. Subaqueous drift, beach formations.

87. Beloit.—Glacial flood deposits; terraces, Trenton, St. Peters.

88. St. Louis and R. I. Division.—Upper Alton to Winchester. Loess.

Wisconsin.^{1 2 3}

LIST OF THE GEOLOGICAL FORMATIONS IN WISCONSIN.

20. Quaternary. } Post Glacial. ² Glacial. 10. Hamilton (Milwaukee Cement Rock). 7. Lower Helderberg. 5 c. Niagara Limestone. ³ 5 b. Clinton. ⁴ 4 c. Cincinnati Shale. 4 b. Galena Limestone.		4 a. Trenton Limestone. ⁴ 3 c. St. Peter's Sandstone. 3 a. Lower Magnesian (Calclferous). ⁵ 2 b. Potsdam Sandstone. ⁷ Keweenaw or Copper-bearing series. 1 b. Huronian. 1 a. Laurentian.	
Chicago & North-Western Railroad. Ms. Chicago, St. Paul & Minneapolis Line. Alt.		Chicago & North-Western Railroad. Ms. Chicago, St. Paul & Minneapolis Line. Alt.	
0 Chicago.	(As before.)	158 Dane.	{ 3 a. Lower Magn.l.s. (on top of high dividing ridge.) ¹⁰⁵⁸
90 Beloit.	{ 4 b. Galena l. s. 4 a. Trenton l. s. ⁷⁴⁵ 3 c. St. Peter's s. s.		{ 3 a. Lower Magn.l.s. capping bluffs.
98 Afton.	{ 4 a. Trenton l. s. ⁷⁵⁸ 3 c. St. Peter's s. s.	158 Lodi. ⁸⁴⁸	{ 2 b. Mad.s.s. } bluff 2 b. Mend.s.s. } sides.
104 Hanover.	4 a. Trenton l. s. ⁷⁸⁰		2 b. Potsdam s. s. valley bottom.
107 Footville.	{ 4 a. Trenton l. s. ⁸¹⁶ 3 c. St. Peter's s. s.	164 Merrimac.	2 b. Potsdam s. s. ⁷⁹⁶
111 Magnolia.	Junc. Tren. and St. P.		{ 1. Archæan q'rtzite.
116 Evansville.	4 a. Trenton l. s. ⁸⁹⁸	172 Devil's Lake.	{ 2 b. Potsdam s. s. and conglom.
122 Brooklyn.	20. Moraine Drift.		{ 1. Archæan q'rtzite.
128 Oregon.	{ 4 a. Trenton l. s. ⁹⁵² 3 c. St. Peter's s. s.	175 Baraboo.	{ 2 b. Potsdam s.s. ⁸⁶¹
138 Syene. ⁹⁰⁸	{ 3 c. St. Peter's s. s. 3 a. Lower Magn.l.s.	181 North Freedom.	2 b. Potsdam s. s.
	{ Moraines, Drumlins. 3 a. Lower Magn.l.s. 2 b. Madison s.s. ⁸⁴⁸ Mendota limestone. Potsdam sandstone.	184 Ableman's.	{ 1. Archæan q'rtzite. 2 b. Potsdam s. s. (in gorge 200 ft. deep, unconformability & exact junc.) ⁸⁷⁸
148 Mendota.	In out, { 3 a. L. Magn. 2 b. Mad.s.s.	191 Reedsburg.	2 b. Potsdam s. s. ⁸⁷⁷
	{ 3 a. Lower Magn.l.s. on bluffs. ⁹²² 2 b. Potsdam s. s.	198 Lavallo. 205 Wonowoc. 208 Union Centre. 212 Elroy.	" ⁸⁹⁷ " ⁹¹¹ " ⁹⁴⁴ " ⁹⁵⁵

1. Prepared by Professor T. C. Chamberlin, of Madison, the State Geologist, and Professors R. D. Irving and M. Strong, Assistant Geologists.

2. Including the Champlain and Terrace epochs.

3. Including four sub-divisions in the southern part of the State and six in the northern, among which are the Racine and Guelph limestones.

4. The Clinton produces the Iron Ridge iron ore, the fossil ore of other States.

5. Including two sub-divisions in the lead region and four in southeastern Wisconsin.

6. The Calclferous may include more than the Lower Magnesian.

7. Including several sub-divisions, among them the Madison sandstone and the Mendota limestone.

Chicago & North-Western Railroad.—Con.			Chicago & North-Western Railroad.—Con.		
Ms.	Chicago, St. Paul and Min. Line.	Alt.	Ms.	Minnesota Division.—Continued.	Alt.
212	Elroy.	2 b. Potsdam s. s. 955	260	Salem.	2 b. Pots. s. s. Ter. 749
226	Camp Douglas. ¹	" 929	267	Winona Junc.	2 b. Pots. s. s. Ter. 655
227	Wis. Val. Junc.	" 928			
242	Lowery's.	" 959	276	La Crosse.	{ 2 b. Pots. s. s. L. Mag. Valley drift. 699
244	Warren's.	" 1019			
249	Rudd's.	" 974	267	Winona Junc.	2 b. Potsdam s. s. 655
			269	Onalaska.	{ 2 b. Potsdam s. s. Valley drift.
265	Bl'k River Falls.	{ 2 b. Potsdam s. s., resting on 1 Arch-sean gneiss. 802	273	Midway.	{ 2 b. Potsdam s. s. Valley drift.
277	Merrillan.	2 b. Potsdam s. s. 928	278	Lytles.	{ 2 b. Potsdam s. s. Valley drift.
282	Humbird.	" 1018	284	Trempealeau.	{ 2 b. Pots. s. s. Loess drift. 620
289	Fairchild.	" 1066	292	Marshland.	{ Potsdam s. s. 8 a. Low. Magn. 659
299	Augusta.	" 965	297	Winona.	(See Minnesota.)
309	Fall Creek.	" 929			
321	Eau Claire. ²	" 886			
328	West Eau Claire.	" 877			
332	Elk Mound.	" 926			
339	Rusk.	Pots. s. s. { Glacial 901			
344	Menomonee.	Pots. s. s. { flood pl. 878			
358	Knapp.	3 a. Lower Magn. 919			
358	Wilson.	20. Quaternary. 1147			
361	Hersey.	" 1168			
369	Baldwin.	" 1182			
372	Hammond.	{ 20. Quat. & 8 c. St. Peter's. 1100			
378	Roberts.	Moraine West. 1086			
390	Hudson. ³	2 b. Potsdam. 700			
401	River Falls.	{ 3 a. Lower Magn. 2 b. Potsdam, Glacial flood drift, Moraine.			
394	Stillwater Junc.	Moraine hills.			
410	St. Paul.	(See Minnesota.)			
Kenosha and Rockford Division.			Milwaukee, Green Bay and Marquette Line.		
0	Kenosha.	20. Quaternary. 618	0	Chicago.	(As before.)
6	Pleasant Prairie.	" 697	45	State Line.	20. Quaternary.
10	Woodworth.	" 748	51	Kenosha.	" 618
12	Bristol.	" 769	60	Racine Junc. ⁵	{ 5 c. Niag. (Racine) limestone. 621
15	Salem.	" 776	62	Racine. ⁵	{ 5 c. Niag. (Racine) limestone. 698
19	Fox River.	" 778	70	County Line.	20. Quaternary. 698
22	Bassett.	" 842	75	Oak Creek.	" 664
27	Genoa Junction.	" (See Illinois.)	81	St. Francis.	" 643
44	Harvard Junc.	"	83	Elizabeth St.	"
72	Rockford.	"	85	Milwaukee. ⁶	{ 10. Hamilton cement rock. 584
					{ 5 c. Niagara.
			90	Lake Shore Junc.	20. Quaternary. 642
			91	Lindivern.	" 638
			100	Granville.	5 c. Niagara, Drift. 738
			107	Germantown.	" 863
			112	Jackson.	" 897
			119	West Bend.	{ 20. Moraine, and fluvial drift. 906
			120	Barton.	{ 20. Moraine, and fluvial drift.
			126	Kewaskum.	{ 20. Mor. and fluvial d't. 5c. Niag. 959
			133	New Cassel.	{ 20. Mor. and fluvial d't. 5 c. Niag.
			140	Eden.	{ 20. Mor. and fluvial d't. 5 c. Niag.
			148	Fond du Lac.	{ 4 b. Gal. red clay drift. 769
					{ 4 b. Galena.
			165	Oshkosh.	{ 4 a. Tren. Striae, Till and Red Clay. 753
			178	Menasha and Neenah.	{ 4 a. Tren. Striae, Till and Red Clay. 756

1. *Camp Douglas.* Remarkable castellated outliers.2. *Eau Claire.* Glacial valley drift carved into fine terraces.3. *Hudson.* Potsdam, glacial flood deposits and terraces.4. *Sparta.* Terraces, artesian wells. Tunnels in or below Lower Magnesian limestone.5. *Racine.* Glacial and lacustrine drift. Ancient beach lines.6. *Milwaukee.* Glacial and lacustrine drifts.

Chicago & North-Western Railroad.			Chicago & North-Western Railroad.		
Ms.	Mill., Green Bay & Marq. Line.—Con.	Alt.	Ms.	(Sheboygan and Western R. R.)—Con.	Alt.
180	West Menasha.	{ 4 a. Tren. Striae, Till and Red Clay. 715	69	Green Lake.	{ 4 a. Trenton l. s. 3 c. St. Peter's s.s. 813
185	Appleton.	{ 4 b. Galena. 715	72	St. Marie.	{ 3 a. Low. Magn. l. s.
190	Little Chute.	{ Tren., Red Clay. 707	78	Princeton.	{ 3 a. Lower Magn. l. s. 768
192	Kaukauna.	{ 4 b. Galena, red clay drift. 655	(Madison and Montford Division.)		
198	Wrightstown.	{ 4 b. Galena, red clay drift. Striae. 626	165	Madison.	{ Moraines, drumlins. 3 a. Low. Magn. 648
208	De Pere.	{ 4 b. Galena, red clay drift. Striae. 591	176	Verona.	{ Moraines. 4 a. Trenton. 3 c. St. Peter's. 3 a. Lower Magn. 4 a. Trenton. 3 c. St. Peter's.
214	Ft. Howard and Green Bay.	{ 4 c. Cin. shale. 588	182	Riley's.	{ 3 a. Lower Magn. 4 a. Trenton. 3 c. St. Peter's.
218	Duck Creek.	{ 4 b. Gal., red clay. 588	184	Pine Bluff.	{ 4 b. Galena. 5 c. Niagara. 4 c. Hudson River. 4 b. Galena.
222	Big Suamico.	{ 4 b. Galena, Striae. "	188	Mount Horeb,	{ 4 b. Galena. 5 c. Niagara. 4 c. Hudson River. 4 b. Galena.
228	Little Suamico.	{ " 20. Quaternary. 4 b. Gal. limestone. 4 a. Tren. limestone.	193	Blue Mounds.	{ 4 b. Galena. 5 c. Niagara. 4 c. Hudson River. 4 b. Galena.
233	Brookside.	{ 20. Quaternary. 4 b. Gal. limestone. 4 a. Tren. limestone.	197	Barnevel'd.	{ 4 b. Galena. "
237	Pensaukee.	{ 4 b. Gal. limestone. 4 a. Tren. limestone.	203	Ridgeway.	{ 4 b. Galena. 4 a. Trenton. 3 c. St. Peter. 4 b. Galena.
242	Oconto.	{ 20. Quaternary. "	212	Dodgeville.	{ 4 b. Galena. 4 a. Trenton. 3 c. St. Peter. 4 b. Galena.
252	Cavoits.	{ " 4 a. Trenton l. s. 4 b. Galena l. s. Striae.	220	Edmund.	{ 4 b. Galena. 4 a. Trenton. 3 c. St. Peter. 4 b. Galena.
256	Peshigo.	{ 4 a. Trenton l. s. 4 b. Galena l. s. Striae.	223	Cobb.	{ " "
263	Marinette.	{ " 4 b. Galena l. s. Striae.	227	Montford Junc.	{ " "
264	Monominee.	{ " 4 b. Galena l. s. Striae.	228	Montford.	{ " "
382	Escanaba, Mich.	{ (See Michigan.) in Michigan.)	237	Preston.	{ " "
(Continued in Michigan.)			239	Lancaster Junc.	{ " "
(Lancaster and Woodman Line.)			241	Fennimore.	{ " "
0	Galena, Ill.	{ 4 b. Galena limestone. 4 b. Galena l. s. 4 a. Trenton l. s.	248	Werley.	{ 4 a. Trenton. 3 c. St. Peter. 3 a. Lower Magn. 2 b. Potsdam. 651
7	Bell's.	{ " "	251	Anderson Mills.	{ 2 b. Potsdam. 651
15	Benton.	{ " "	257	Woodman.	{ 4 b. Galena. 4 b. Galena.
20	St. Rose.	{ " "	246	Liberty.	{ " "
32	Platteville.	{ 4 b. Galena l. s. 4 a. Trenton l. s.	251	Lancaster.	{ " "
(Sheboygan and Western Railroad.)			234	Livingston.	{ " "
0	Sheboygan.	{ 5 c. Niagara. Sub-aqueous drift. 588	238	Rewey.	{ " "
5	Sheboygan Falls.	{ 5 c. Niagara. Sub-aqueous drift. 653	245	Leslie.	{ " "
10	Town Line.	{ 20. Drift. 840	247	Mineral Point Jc.	{ " 925
14	Plymouth.	{ 20. Red clay. 840	249	Platteville Jc.	{ " "
20	Glenbeulah.	{ Kettle Range. 867	253	Platteville.	{ 4 a. Trenton and Ga. 4 b. Galena.
26	St. Cloud.	{ Moraine drift. 827	254	Elmo.	{ 4 b. Galena. "
30	Calvary.	{ 5 c. Niag. l. s. 827	256	St. Rose.	{ " "
43	Fond du Lac.	{ Niag. drumlins. 940	257	Cuba City.	{ " "
44	Fond du Lac Jc.	{ 4 b. Galena l. s. 746	260	Benton.	{ " "
47	Woodhull.	{ " 875	262	Strawbridge.	{ " "
52	Eldorado.	{ " 891	264	Buncomb.	{ " "
55	Rosendale.	{ " 882	268	Millbrig.	{ " "
57	West Rosendale.	{ " 882	275	Galena.	{ Loess, Terraces. 4 b. Galena.
63	Ripon.	{ 4 b. Galena l. s. 4 a. Trenton l. s. 930 3 c. St. Peter's s. s. 3 a. Lower Magn. l. s.			

Chicago & North-Western Railroad.—Con.
Ms. (Milwaukee to Madison and Montford.) Alt.

0 Chicago.	(As before.)
85 Milwaukee.*	{ 10. Ham'n cem. rock. 5 c. Niagara. 884
96 North Greenfield.	20. Drift.
97 Calhoun.	"
102 Waukesha.	5 c. Niagara. 808
110 Wales.	20. Kettle Moraine.
115 Dousman.	"
121 Sullivan.	20. Drift, Kames near.
132 Jefferson Junc.	20. D't, Drumlins. 799
139 Lake Mills.	20. Drift Kames.
144 London.	20. Drift, Drumlins.
154 Cottage Grove.	20. Drift.
165 Madison.	{ 20. Morainic Drift. 3 a. Low. Magn. 848 2 b. Pots. & Mad.s.s.

(Janesville, Watertown & Fond du Lac.)

0 Chicago.	(As before.)
70 Sharon.	20. Drift.
78 Clinton Junc.	" 941
82 Shopiere.	20. D't. 4 b. Gal.l.s. 944
91 Janesville.	{ 4 a. Tren. 8 c. St.P'r's Glacial flood plain.
99 Milton Junction.	20. Quaternary. 877
104 Koshkonong.	20. Drift. 827
110 Ft. Atkinson.	4 b. Gal., Drift. 798
116 Jefferson.	20. Drift. 799
119 Jefferson Junc.	20. Drift, Drumlins.
121 Johnson's Creek.	" 771
129 Watertown Jc.	4 b. Gal., Drumlins. 821
130 Watertown.	"
138 Clyman.	Drumlins. 908
145 Juneau.	Drumlins. 918
148 Minnesota Junc.	20. Drift. Galena.
151 Burnett Junc.	" 877
160 Chester.	"
168 Oakfield.	" 888
176 Fond du Lac.	{ 4 b. Galena l. s. Red Clay. 746
184 Van Dyne.	Lacustrine deposit.
193 Oshkosh.	{ 4 b. Galena l. s. 4 a Trenton l. s. 758

Chicago, St. Paul, Min. & Omaha R. R.
Ms. (St. Paul and Lake Superior Division.) Alt.

0 Minneapolis.	{ 4 a. Trenton. 8 c. St. Peter. Moraine, Glacial flood deposits.
10 St. Paul.	
80 Hudson.	8 b. Potsdam. " 708
88 N. Wisconsin Jc.	20. Quaternary. 872
41 Boardman.	{ 2 b. Potsdam, Moraine drift. 887
46 New Richmond.	8 a. Lower Magn. 889
55 Deer Park.	20. Moraine.

Chicago, St. Paul, Min. & Omaha R. R.
Ms. (St. Paul and Lake Superior Div.)—Con. Alt.

68 Clear Lake.	20. Moraine, west.
71 Clayton.	"
75 Turtle Lake.	20. Morainic drift.
79 Perley.	"
88 Cumberland.	"
95 Barronett.	"
104 Shell Lake.	20. Moraine summit.
110 Spooner.	20. Gravel drift.
118 Veazie.	20. Glacial fl'd deposit.
130 Stinnett.	"
136 Hayward.	"
153 Cable.	20. Moraine.
163 Drummond.	"
177 Mason.	20. Red clay drift.
190 Ashland Junc.	"
194 Ashland.	"
190 Ashland Junc.	"
198 Washburne.	2 b. Potsdam, Drift.
211 Bayfield.	"

(Eau Claire and Lake Superior Division.)

0 Eau Claire.*	Pots. and Val. d't. 886
10 Chippewa Falls.*	{ 2 b. Potsdam. 1. Archæan granite.
25 Bloomer.	2 b. Potsdam, Drift.
38 Cartwright.	"
42 Chetek.	2 b. Pots., gravel hills.
49 Cameron.	2 b. Potsdam. } Gravel
56 Rice Lake.	" } plain.
81 Spooner.	Moraine.
113 Gordon.	{ 20. Ancient outlet of Lake Superior.
139 Douglass.	{ 2 b. Potsdam. Keweenawan.
150 Superior.	20. Red clay drift

(Neillsville Branch.)

0 Neillsville.	2 b. Potsdam s. s. 928
14 Merillan.	"

Chicago, Milwaukee & St. Paul Railroad.
Ms. (Chicago, St. Paul & Minneapolis Line.) Alt.

0 Chicago.	(As before.)
48 Wadsworth.	20. Quaternary.
52 Kenosha Junc.	" 679
53 Truesdell.	" 679
62 W. U. Junction.	" 722
85 Milwaukee.*	{ 10. Hamilton, Mil. Cement Rock. 884 5 c. Niagara l. s.
98 Brookfield.	20. Quaternary. 884
109 Pewaukee.	{ 5 c. Niag., Strias, Drumlins east. 841
109 Hartland.	{ 20. Moraine fluvial drift. 888

Chicago, Milwaukee & St. Paul Railroad. Ms. (Chicago, St. Paul and Min. Line.)—Con. Alt.			Chicago, Milwaukee & St. Paul Railroad. Ms. (Prairie du Chien Division.)—Con. Alt.		
111	Nashotah.	{ 20. Moraine, fluvial drift. 861	42	Palmyra.	{ Inner border of Kettle Moraine. 888
116	Oconomowoc.	" 861	51	Whitewater. ¹²	{ 4 b. Galena l. s. 819
129	Watertown.	{ 4 b. Galena l. s., drumlins. 821	56	Lima.	{ 20. Quat., feeble moraine, E. 888
180	Watertown Jc.	" 821	62	Milton. ¹³	Quaternary. 871
189	Reeseville.	20. Drumlins.	64	Milton Junction.	" 877
144	Elba.	"	71	Edgerton.	{ 4 a. Trenton. 820
148	Columbus.	{ L. Magn. l. s. drift. 884	81	Stoughton.	{ 3 c. St. P. s. s. d'ft hills 20. Quat. heavy d'ft. 857
152	Fall River.	" 888	89	McFarland.	{ 20. Heavy drift. 867
158	Doylestown.	" 888	96	Madison.	{ 3 a. Low. Magn. l. s. 20. Mor. drift. 848
168	Rio.	"			{ 3 a. Low. Magn. l. s. 2 b. Madison s. s. 2 b. Mendota l. s. 2 b. Pots. s. s. 925
168	Wyocena.	{ 2 b. Madison s. s. 2 b. Mendota s. s. 2 b. Pots. s. s. 827	102	Middleton.	{ 2 b. Pots. s. s. 925 3 a. Low. Magn. l. s. (Kettle Moraine.) 2 b. Mad. s. s. { bluff 2 b. Men. l. s. { sides 2 b. Pots. s. s. valley bottom. 858
176	Portage City. ⁷	2 b. Potsdam s. s.			" 810
198	Kilbourn. ⁸	{ 2 b. Pots. s. s. finely exposed in dalles of Wisconsin. 893	110	Cross Plains.	" 773
202	Lyndon.	2 b. Potsdam s. s.			2 b. Potsdam s. s. 782
209	Lemonweir.	" 894	115	Black Earth.	{ 3 a. Low. Magn. on bluffs. 722
212	Mauston. 887	" { fine cas-	119	Mazomanie.	2 b. Potsdam s. s. on low ground. 704
220	Lisbon. 898	" { toldated	125	Arena.	2. b. Pots. in the valley. Ad- 898
225	Camp D'glas. 929	" { outliers. 867	182	Spring Green.	jacent bluffs 857
288	Tomah.	"			capped with 3 867
242	Greenfield.	"	189	Lone Rock.	a. Low. Magn. 888
249	Lafayette.	"	145	Avoca.	limestone.
255	Sparta. ⁴	" " 786	151	Muscoda.	8 a. Lower Magn. 818
265	Bangor.	2 b. Pots. s. s. ter. 782	166	Boscobel.	29. Quaternary. 877
270	West Salem.	" 655	176	Wauzeka.	{ 4 a. Trenton. 818
277	Winona Junc.	"	183	Wright's Ferry.	{ 3 c. St. P. s. s., Drift. | St. Peter's s. s. 798
280	La Crosse.	{ 2 b. Pots. s. s., 3 a. Low. Magn. val. d'ft. 698	186	Bridgeport.	4 b. Galena l. s. 870
410	St. Paul.	(See Minnesota.)	194	Prie du Chien. ¹⁴	4 b. Galena l. s. 788
420	Minneapolis.	"			"
(Prairie du Chien Division.)			64	Milton Junction.	29. Quaternary. 877
0	Milwaukee. ⁶	{ 10. Ham. cement rock 5 c. Niagara l. s. 884	71	Janesville,	{ 4 a. Trenton. 818
6	Wauwatosa.	{ 5 c. Niagara. Striae, Drift. 651	78	Hanover.	{ 3 c. St. Peter's, gla- cial flood plain.
10	Elm Grove.	20. Quaternary. 748			{ 4 a. Tren. l. s. glacial b'kwater pl'n. 780
14	Brookfield Jc.	" 824	88	Orford.	{ 4 a. Tren. l. s. 898
17	Forest House.	" 818	80	Brodhead. ¹⁵	{ 3 c. St. P. s. s., Drift. | St. Peter's s. s. 798
21	Waukesha.	{ 5 c. Niagara. Striae, Drift. 803	105	Monroe. ¹⁶	4 b. Galena l. s. 870
28	Genesee. ⁹	" 903	113	Browtown.	" 788
81	North Prairie. ¹⁰	20. Quaternary. 941	127	Gratiot.	"
87	Eagle. ¹¹	{ Kettle Moraine 948 Glacial gravel plain.	138	Shulsburg.	"

7. Portage City. Fluvial drift, moraine between Portage and Kilbourn.

8. Kilbourn. Beautiful exhibitions of fluvial erosion in Dalles of the Wisconsin.

9. Genesee. Drumlins east and moraines and kames west of Genesee.

10. North Prairie. Till, fluvial drift; moraines and kames east and west of this place.

11. Eagle. Glacial flood plains.

12. Whitewater. Drumlins; striae. Kettle moraine south of this place.

13. Milton. Moraines north and south, glacial flood drift.

14. Prairie du Chien. Potsdam; valley drift; artesian wells.

15. Brodhead. Trenton (capping bluffs east). Glacial flood plain.

16. Monroe. Border of drift. Glacial gravel capped with till.

Chicago, Milwaukee & St. Paul Railroad.			Chicago, Milwaukee & St. Paul Railroad.		
Ms.	Madison Division.	Alt.	Ms.	Northern Division.—Continued.	Alt.
0	Madison.	3 a. Lower Magn. ⁸⁴⁸	54	Horicon Junc.	20. Quaternary. ⁸⁸⁴
12	Sun Prairie.	4 a. Trenton, Drift.	57	Minnesota Junc.	" ⁹²⁶
18	Deanville.	{ 4 a. Trent. Drift. ⁸⁷³ Drumlins. ⁸⁷³	59	Rolling Prairie.	" ⁹⁴¹
20	Marshall.	{ 20. Quat. 4 a. Trent. ⁸⁶⁴ Drift; Drumlins. ⁸⁶⁴	68	Beaver Dam.	{ 4 b. Galena l s ⁹¹⁸ Tren. l.s., drumlins.
23	Waterloo. ¹⁷	{ 4 a. Trenton l. s. ⁸¹⁹ 3 a. Lower Magn. l.s. ⁸¹⁹	69	Fox Lake Junc.	4 a. Trenton l. s. ⁸⁸⁸
27	Hubbleton.	1 a. Arch. Quartzite.	74	Randolph.	{ 4 a. Trenton l. s. ⁹⁵⁶ 3 c. St. Peter's s. s. ⁹⁵⁶ 3 a. Lower Magn. l.s. ⁹⁵⁶
87	Watertown Junc.	Subaqueous drift. ⁸²¹ 4 b. Galena l. s. ⁸²¹	80	Cambria.	{ 3 a. Lower Magn. l.s. ⁸⁶² 2 b. Madison s.s. ⁸⁶² 2 b. Mendota l. s. ⁸⁶² 2 b. Potsdam s. s. ⁸⁶²
Northern Division.			90	Pardeeville.	2 b. Potsdam s. s. ⁸¹⁰
0	Milwaukee. ⁶	{ 10. Hamilton, Mil- waukee Cem. Rock ⁸⁸⁴ 5 c. Niagara l. s. ⁸⁸⁴	98	Portage City. ⁷	"
9	Schwartzburg.	" ⁶⁴⁸	Madison and Portage Division.		
15	Granville.	" ⁷⁸⁸	0	Madison.	(As before.) ⁸⁴⁸
20	Germantown.	" ⁸⁶⁸	1	East Madison.	" ⁸⁴⁸
25	Richfield. ¹⁸	20. Quaternary. ⁹⁸⁹	12	Windsor.	{ 3 a. Lower Magn. l.s. ⁸⁸⁸ 2 b. Potsdam s.s. ⁸⁸⁸
88	Schleisingville.	{ Kettle Moraine. ¹⁰⁵² Glac'l flood d'ft. ¹⁰⁵²	16	Morrison.	8 a. L. Magn. l. s. ⁹⁶⁵
87	Hartford.	{ 5 c. Niag. l. s. ⁹⁸⁸ 5 b. Clin. iron ore. ⁹⁸⁸ 4 c. Cin. shale. ⁹⁸⁸	21	Arlington.	{ 3 c. St. Peter's s. s. ¹⁰⁰⁴ 3 a. L. Mag. l.s. ¹⁰⁰⁴
41	Rubicon.	20. Quaternary. ¹⁰¹⁸	25	Poynette.	2 b. Potsdam s. s. ⁷⁹³
46	Woodland.	" ⁹⁵¹	39	Portage.	"
47	Iron Ridge.	{ 5 c. Niagara l. s. ⁹²⁸ 5 b. Clin. iron ore. ⁹²⁸ 4 c. Cin. Shale. ⁹²⁸	Racine and Southwestern Division.		
76	Fond du Lac.	{ 4 b. Galena. ⁷⁶⁹ Red drift clay. ⁷⁶⁹	0	Racine. ⁶	Niag. (Racine) ls. ⁶¹⁸
54	Horicon Junc.	20. Quaternary. ⁸⁸⁴	2	Junction.	" ⁸⁸¹
59	Burnett Junc.	" ⁸⁷⁷	8	W. U. Junc.	Deep drift, (Till) ⁸⁸³
68	Waupun.	4 b. Gal., Striae. ⁸⁹²	10	Windsor.	" ⁸⁸³
76	Brandon.	20. Quaternary. ¹⁰⁰⁰	15	Union Grove.	" ⁷⁶⁰
83	Ripon.	{ 4 b. Galena l. s. ⁹⁸⁰ 4 a. Trenton l. s. ⁹⁸⁰ 3 c. St. Peter's s. s. ⁹⁸⁰ 3 a. Lower Magn. l.s. ⁹⁸⁰	18	Kansasville.	" ⁸¹⁸
96	Berlin. ¹⁹	{ 3 a. Lower Magn. l.s. ⁷⁶² 2 b. Potsdam s.s. ⁷⁶² 1 Arch. Porphyry. ⁷⁶²	27	Burlington.	5 c. Niag., Moraine ⁷⁸¹ Niag. ls. Moraine ⁸⁰⁰
90	Picket's.	4 a. Trenton limestone. ⁷⁵³	31	Lyons.	{ Till & gravel hilla. ⁸⁴⁸ 20. Till and gravel ⁸⁴⁸ hilla. ⁸⁴⁸
102	Oshkosh.	{ 4 b. Galena l. s. ⁷⁵³ 4 a. Trenton l. s. ⁷⁵³	34	Springfield.	20. Heavy drift. ⁹⁹¹
90	Rush Lake.	3 a. L. Magn., Striae. ⁸⁴¹	41	Elkhorn.	{ 20. " ⁹⁹¹ & gravel. ⁹⁹¹
95	Waukau.	L. Magn. Red d'ft clay. ⁸⁴¹	46	Delavan.	20. Moraine. ⁹⁴⁵
99	Omro.	{ 20. Quat., Red drift ⁸⁴¹ clay. ⁸⁴¹	50	Darien.	Heavy drift. ⁸⁷¹
104	Winneconne. ²⁰	3 a. L. Magn. l. s. ⁸⁴¹	54	Allen's Grove.	" ⁹⁴¹
			59	Clinton.	{ Galena & Trenton ls. ⁷⁴⁰ St. Peter's s. s. ⁷⁴⁰ Glac'l flood grav. ⁷⁴⁰
			(Continued in Illinois.)		
			0	Eagle.	Kettle Moraine. ⁹⁴³
			6	Troy Center. ²¹	Heavy drift. ⁸⁷³

17. Waterloo. Drumlins; heavy drift; boulder train.

18. Richfield. Heavy drift; kettle moraine west.

19. Berlin. Red clay drift; boulder train.

20. Winneconne. Lower magnesian limestone domes east; heavy drift.

21. Troy Centre. Till and glacial flood deposits.

22. Amherst. Moraine east; glacial flood plain west of this place.

Chicago, Milwaukee & St. Paul Railroad.Ms. Racine and Southwestern Div.—*Con.* Alt.

9 Mayhew's.	20. Heavy drift.	
11 Fayette.	" "	881
17 Elkhorn.	" "	991

Wisconsin Valley Division.

0 Tomah.	2 b. Potsdam s. s.	967
7 Valley Junction.	" "	984
10 Norway.	" "	985
18 Beaver.	" "	988
29 Remington.	" "	981
42 Port Edwards.	{ 2 b. Potsdam s. s. on 1. Arc'n Gneiss.	972
46½ Centralia.	" "	1015
54 Rudolph.	1. Archæan, Drift.	1146
60 Junction City.	" "	1145
70 Knowlton.	" "	1181
76 Mosinee.	" "	
89 Wausau.	" "	1227
08 Trap City.	" "	
102 Pine River.	" "	
107 Merrill.	" "	

Mineral Point Division.

0 Mineral Point.	{ 4 b. Gal. l. s. 4 a. Trent. l. s. 3 c. St. Peter's s. s.	935
10 Calamine.	{ 4 b. Gal. l. s. 4 a. Trent. l. s. 3 c. St. Peter's s. s.	812
20 Belmont.	4 b. Galena limestone.	
28 Plattville.	{ 4 b. Galena l. s. 4 a. Trenton l. s.	
0 Mineral Point.	(As before.)	985
10 Calamine.	" "	812
16 Darlington.	4 a. Trent. l. s.	802
26 Gratiot.	{ 4 b. Gal. l. s. 4 a. Trent. l. s.	788
33 Warren.	(See Illinois.)	

Prairie du Chien Division.—*Con.*

119 Mazomanie.	Pots. s.s., Val. drift.	778
127 Sauk City.	{ 3 a. L. Mag. l. s. 2 b. Pots.	788
129 Prairie du Sac. 25	{ 3 a. L. Mag. l. s. 2 b. Pots.	
139 Lone Rock.	2 b. Pots. in val.	704
145 Richland City.	Adjacent bluffs cap'd	
149 Twin Bluffs.	with 3 a. L. Mag. l. s.	
155 Richland Cent.	3 a. L. Mag. l. s.	

Chippewa Valley Division.

0 Wabasha, Minn.	2 b. Potsdam s. s.	
1 Reads Juno.	Alluvial bottoms.	

Chicago, Milwaukee & St. Paul Railroad.Ms. Chippewa Valley Division.—*Con.* Alt.

19 Durand.	{ 2 b. Pots. Bluffs cap'd with 3 a. L. Mag. l. s.	
25 Red Cedar.	Valley d'ft. terraces.	
26 Red Cedar Juno.	{ 2 b. Pots. & 3 a. L. Mag. l. s. in adj. hills.	
32 Meridean.	{ 2 b. Pots. & 3 a. L. Mag. l. s. in adj. hills.	
48 Porterville.	{ 2 b. Pots. & 3 a. L. Mag. l. s. in adj. hills.	
47 Shawtown.	{ 2 b. Pots. & 3 a. L. Mag. l. s. in adj. hills.	
48 Eau Claire. 2	20. Glac. val. d'ft.	820
54 Lafayette Mills.	{ Terraces, 2 b. Pots. s. s.	888
56 Badger Mills.	Terraces, 2 b. Pots. s. s.	
62 Chippewa Falls. 23	{ 1. Archæan granite. 2 b. Potsdam s. s.	

Menomonee Branch.

26 Red Cedar Juno.	{ Val. d'ft. terraces; 2 b. Pots. & 3 a. L. Mag. in hills.	
28 Dunnville.	{ Val. d'ft. terraces; 2 b. Pots. & 3 a. L. Mag. in hills.	
41 Menomonee.	{ 2 b. Pots., Glac. flood plain, terraces.	878

Green Bay, Winona & St. Paul Railroad.

0 Green Bay.	{ 5 c. Niag. l. s. 4 c. Cin. shale. 4 b. Galena l. s.	888
10 Oneida.	" "	
17 Seymour.	{ 4 a. Trenton l. s. 3 c. St. Peter's s. s.	
28 Black Creek.	3 a. Lower Magn. l. s.	
31 Shiocton.	20. Quaternary.	
39 New London.	{ 3 a. L. Magnesian l. s. 2 b. Potsdam s. s., Red clay drift.	
46 Royalton.	20. Quaternary.	822
50 Manawa.	" "	824
55 Ogdensburg.	" "	870
61 Scandinavia.	Kettle Mor. W. of	935
78 Amherst. 22	{ Kettle Moraine. 2 b. Potsdam s. s.	1044
82 Plover.	Glacial flood plain.	
96 Grand Rapids.	{ 1. Archæan Gneiss overlaid by 2 b. Potsdam s. s. and altering into Kaolin.	1024
111 Dexterville.	2 b. Pots. s. s.	1001
119 Scranton.	" "	962

23. Chippewa Falls. Glacial flood deposit; terraces.

24. Sauk City. Drift Margin. Border of the driftless area.

25. Prairie du Sac. Kettle moraine and valley overwash.

26. Wabasha. Bluffs capped with Lower Magnesian limestone. Valley drift terraces.

Green Bay, Winona & St. Paul Railroad.—Continued.			Milwaukee, Lake Shore & Western Railroad.—Continued.		
Ms.		Alt.	Ms.		Alt.
142	Hatfield.	2 b. Potsdam s. s.	100	Brillion.	{ 5 c. Niag. Red drift clay.
149	Merrillan.	" 943	104	Forest Junc.	20. Quaternary. 828
153	Alma Center.	"	113	Kaukauna.	" 722
159	Hixton.	"	116	Little Chute.	" 706
166	Taylor.	"	120	Appleton.	4 a. Trent., Red Clay.
172	Blair.	"	122	Appleton Junc.	3 a. L. Magn., drift.
179	Whitehall.	"	134	Hortonsville Junc.	"
193	Arcadia.	" Val. d't Ter.	140	New London.	"
210	Marshland.	{ 2 b. Pots. s. s. 650 3 a. L. Magn. l. s.	141	New London Junc.	"
214	Winona.	(See Minnesota.) 655	150	Bear Creek.	20. Drift.
Milwaukee, Lake Shore & Western R. R.			157	Clintonville.	"
0	Milwaukee. "	{ 10. Hamilton Cement Rock. 584 5 c. Niagara l. s.	164	Marion.	"
4	Lake Shore Junc.	20. Quaternary. 642	176	Tigerton.	1. Archæan granite.
6	White Fish Bay.	{ 10. Hamilton, Red clay drift. 654 20. Quat., Red clay drift. 668	188	Eland Junc.	1. Archæan, Drift.
10	Dillman's.	"	192	Biramwood.	"
13	Mequon.	" 697	198	Aniwa.	"
20	Ula.	" 697	202	Elmhurst.	"
25	Port Washington.	{ 5 c. Niag., Red drift clay. 669 " 756	208	Antigo.	Archæan, Glac. gravel.
31	Decker's.	"	209	Wolf River Junc.	"
33	Belgium.	{ 20. Quat. Red drift clay. 755 " 697	217	Bryant.	"
38	Cedar Grove.	" 698	220	Malcom.	" Moraine.
42	Oostburg.	" 700	225	Summit Lake.	"
46	Wilson.	"	235	Pelican.	" Heavy d'ft.
48	Weeden's.	"	241	Monico.	"
52	Sheboygan.	{ 5 c. Niag. l. s., Red clay drift, Stria. 533 20. Quat. Red drift clay. 639	267	Eagle River.	"
58	Mosel.	" 637	293	Watersmeet.	"
64	Centreville.	" 657	310	Gogebic.	{ 1 b. Potsdam. Keweenawan. 1 b. Huronian.
69	Newton.	"	0	Eland Junc.	1 Archæan Gran. d'ft.
77	Manitowoc.	{ 5 c. Niag. l. s. Red drift clay. 598 20. Moraine west. 729	2	Norris.	20. Drift.
84	Branch.	5 c. Niagara. 844	22	Wausau.	1 Archæan.
89	Cato.	" 845	Milwaukee & Northern Railroad.		
91	Grimms.	"	Milwaukee Division.		
94	Reedville.	"	0	Milwaukee. "	{ 10. Hamilton Cement Rock Drift. 584 5 c. Niagara l. s.
100	Brillion.	"		Schwartzburg.	5 c. Niagara. 648
104	Forest Junction.	20. Quaternary. 830	18	Thienville.	20. Quaternary.
108	Dundas.	" 832	23	Cedarburg.	5 c. Niagara l. s. 773
113	Kaukauna.	4 b. Galena. 655	25	Grafton.	" 752
116	Little Chute.	" 707	29	Saukville.	" 763
120	Appleton.	{ 4 b. Galena l. s. 715 4 a. Trenton l. s.	36	Fredonia.	" 788
77	Manitowoc.	20. Quaternary. 592	41	Random.	20. Quaternary. 877
84	Two Rivers.	" 586	46	Sherman.	" 835
78	Manitowoc.	{ 5 c. Niag., Red drift clay. 598 " 824	50	Waldo.	" 836
89	Cato.	" 824	55	Plymouth.	" 844
94	Reedsville.	" 820	62	Elkhart Lake.	{ 20. Moraine. Kettle Range.
			68	Kiel.	5 c. Niag., Mor. E. 915
			72	Holstein.	20. Quaternary.
				Hayton.	" 822
			79	Chilton.	" 815
			86	Hilbert.	"

Milwaukee & Northern Railroad.—Con.			Wisconsin Central Line.—Con.		
Ma.	Milwaukee Division.	Alt.	Ms.		Alt.
86	Hilbert.	20. Quaternary.	107	Medina.	8 a. L. Mag. ls. 513
91	Forest Junction.	" 535	110	Dale.	" "
	Holland.	" "	124	Weyauwega.	2 b. Pots. ss. 523
99	Greenleaf.	" "	181	Waupaca.	1. Archæan. 599
	Ledgeville.	5 c. Niagara.	188	Sheridan. 1017	Kettle Moraine.
109	De Pere.	4 b. Gal., R. C. d'ft. 591	144	Amherst.	" 1089
		{ 5 c. Niagara l. s.			{ Pots. ss. and Arch.
118	Green Bay.	{ 4 c. Cin. shale. 588	160	Stevens' Point.	{ Gneiss. Gl. flood
		{ 4 b. Gal. l. s.			{ plain. 1090
114	Ft. Howard.	{ 4 b. Gal., l. s., La-	171	Junction City.	1. Archæan. 1145
		{ custrine clay. 584	175	Milladore.	" "
119	Cormier.	4 b. Gal., drift.	183	Auburndale.	{ 1. Arch. overl'd by
124	Tremble.	20 Drift.			{ heavy d'ft. 1217
128	Gardner.	" "	192	Marshfield.	" 1289
141	Grand Trunk Jc.	" "	195	Mannville.	" 1292
146	Maple Valley.	8. L. Magn., Drift.	200	Spencer.	" 1307
153	Coleman. ²⁷	" "	207	Unity.	" 1338
156	Pound.	" "	211	Colby.	" 1315
159	Beaver.	2 b. Pots. s. s., Drift.	218	Abbotsford.	Drift.
165	Ellis Junc.	2 b. Pots., sand plains.	219	Curtiss.	" "
177	Porterfield.	1. Archæan, Drift.	226	Withee.	" "
185	Marinette.	4 b. Gal., drift, Striæ.	236	Thorpe.	2 b. Potsdam, Drift.
187	Menominee.	" "	247	Boyd.	" "
168	Noquebay.	1. Archæan, Drift.	254	Cadott.	" "
176	Wausaukee.	" "	267	Chip'wa Falls. 23	{ 1. Arch. Granite.
185	Pike.	" "			{ 2 b. Potsdam ss.
Appleton Branch.			268	St. Croix Junc.	{ 1. Arch. Granite.
					{ 2 b. Potsdam.
0	Hilbert.	20. Quaternary. 525	278	Morris.	2 b. Potsdam ss.
6	Sherwood.	5 c. Niagara l. s. 535	285	Wiswell.	" "
11	Lake Park.	Lacustrine drift.	288	Colfax.	{ Pots. ss., Glacial
15	Menasha. 532	4 b. Gal. l. s. 4 a. Tren. l. s.			{ flood dep. Terraces.
16	Neenah.	" 748	298	Lochiel.	{ 20. Glacial fl'd dep.
21	Appleton.	" 715			{ Terraces.
Wisconsin Central Line.			307	Barker. ²⁷	2 b. Potsdam, Drift.
			310	Downing.	" "
0	Milwaukee. 6	{ 10. Hamilton Cem't	318	Emerald.	" "
		{ Rock. 584	324	Cylon.	8 a. L. Mag., Drift.
		{ 5 c. Niagara l. s.	333	New Richmond.	" "
82	Schleisingerville	{ 20. Kettle Moraine,	338	Clarendon.	20. Drift. L. Magn.
		{ Glac. flood deposit.	346	St. Croix.	" Pots. & L. Mag.
89	Allentown.	5 c. Niagara ls., Drift.	349	Arcola.	20. Drift.
48	Theresa.	" "	363	Castle.	" "
57	Hamilton.	" "	367	Lake Phalen Jc.	" "
66	Fond du Lac.	4 b. Gal. l. s. 746	372	St. Paul.	(See Minnesota.)
74	Van Dyne.	Lacustrine drift.	Northern Division.		
83	South Oshkosh.	" "	0	Abbotsford.	{ 1. Archæan, overl'd
					{ by heavy d'ft. 1466
84	Oshkosh.	{ Galena & Trenton ls.	4	Dorchester.	" 1413
		{ Lacustrine d'ft. 753	14	Medford.	" "
88	State Hospital.	Lacustrine drift. 748	25	Chelsea.	" 1489
98	Snells.	" "	29	Westboro.	" 1505
97	Neenah.	{ Galena & Trenton ls.	47	Worcester.	" 1454
		{ Striæ, Drift.	55	Phillips.	" "
86	Hilbert.	20. Quaternary.	62	Wauboo.	" 1458
92	Sherwood.	5 c. Niag. l. s. 535	68	Fifield.	" "
98	Menasha.	{ 4 Gal. l. s. 532	79	Butternut.	" "
		{ 4 a. Trent. l. s.	..	Chippewa.	" "

27. The formations given for this station and the following four, occur in the vicinity.

Ms. Wisconsin Central Line.—Con. Alt.			Ms. Wisconsin Central Line.—Con. Alt.		
Northern Division.			Southern Division.		
104	Penokee. ²⁸	{ 1. Hur'n, with iron ore. 1285	71	Portage.	{ 2 b. Pots., overlaid by drift. 792
126	White River.	20. Red clay drift.	55	Packwaukee.	20. Drift.
133	Ashland.	{ 20. Red clay drift. 678	62	Montello.	20. Drift, Granite.
Southern Division.			Minneapolis, Sault Ste. Marie & Atlantic.		
0	Stevens' Point.	(As before.) 1098	0	Turtle Lake.	Morainic drift.
5	Plover.	{ 2 b. Pots., overlaid by drift. 1078	5	Scott's Siding.	"
11	Buena Vista.	"	15	Barron.	20. Glac. flood drift.
22	Plainfield. 1118	Moraine east.	20	Cameron Junc.	"
28	Hancock. 1102	Kettle Moraine.	25	Canton.	20. D'ft., Q'rtzite near.
46	Westfield. 860	" "	31	Hawkins.	"
55	Packwaukee.	" " 784	42	Tibbets Siding.	"
			45	Bruce.	"

28. Unconformability between Huronian and Laurentian finely shown at Penokee.

29. Note.—Where several formations are given it is to be understood that they occur in the vicinity, not necessarily immediately at the station. Also, that where the drift effectually conceals the underlying formations they are not usually given, though in almost all cases definitely known.

Iowa.¹

LIST OF GEOLOGIC FORMATIONS FOUND IN IOWA.

20 b. Loess, (concealing stratified rocks.	13 b. Burlington.
20 a. Glacial Drift " " "	13 a. Kinderhook.
18 Inoceramus.	10. Hamilton.
18 Woodbury.	5 c. Niagara.
18 Nishnabotna.	4 c. Maquoketa.
18 Fort Dodge.*	4 b. Galena Limestone.
14 c. Upper Coal.	4 a. Trenton.
14 b. Middle Coal.	3 b. St. Peter.
14 a. Lower Coal.	3 a. Lower Magnesian.
13 d. St. Louis.	2 b. Potsdam.
13 c. Keokuk.	2 a. Sioux.

Brief Sketch of the Geology of Iowa.

The general geologic structure of Iowa is simple: The prevailing dip of the strata is low, rarely reaching 5°, and south-westerly in direction. In consequence the outcrops of the greater rock series, from the oldest to the newest, form successive zones trending N. W.—S. E., each overlapped on the south-west by the attenuated margin of the next higher series. In detail this structure is modified and complicated by slight diversity in strike and dip and variations in thickness of the several formations, and the regularity of the zones of outcrop is destroyed through erosion by which the north-easterly (and basal) margins of the successive formations are channelled, deeply crenulated, and sometimes cut off in insulated outliers; and some of the major as well as many of the minor features of the stratified rocks are obscured by a mantle of superficial deposits.

The Potsdam is exposed by erosion only in the valley-bottoms of the extreme northeastern corner of the State, where it forms the gently-sloping bases of bluffs 300 to 500 feet high. The steeper medial portion of these bluffs is Lower Magnesian limestone, which, by reason of its firm texture, has well resisted the degradation of the rivers and forms nearly continuous mural or castellated precipices. Both formations disappear on the Oneota (or Upper Iowa) river about the west line of Allamakee county, and on the Mississippi, a few miles south of McGregor. The gentle slopes toward the summits of the bluffs in this region represent the friable St. Peter sandstone, sometimes white as snow, again brown, red or yellow, and elsewhere curiously variegated, as at McGregor, where it forms the "pictured rocks" of Iowa. The generally abrupt escarpment of the Trenton limestone overlooks the easy slopes of the sandstone, and forms a secondary line of bluffs along the Mississippi, Oneota and Yellow rivers in the north, which merges into the immediate river bluffs toward the mouth of Turkey river. The Trenton is the first of the formations to occupy a considerable area. It extends along the Iowa-Minnesota line from a few miles west of the Mississippi to several miles west of Decorah; but by reason of rapid attenuation southward and its confinement to the precipitous Mississippi bluffs below the mouth of the Turkey, the terrane contracts greatly toward Dubuque, where it passes beneath the surface. Almost everywhere the Trenton is richly fossiliferous. The precipitous bluffs at Dubuque represent the Galena limestone, which there has a thickness of 200 or 250 feet, but which rapidly dwindles northwestward. It is the plumbiferous formation of Illinois, Wisconsin, and Iowa, and takes its name from the prevalent form of the ore. From its caverns are brought forth the superb stalactites and crystalline masses of various minerals adorning the lawns and verandas of Dubuque. A narrow belt of soft-contoured hills cleft by spring-born streamlets, or a single gentle slope, rises from the precipices of the Galena and is overlooked by the bold Niagara escarpment. It represents the easily weathered shales and clays of the fossiliferous Maquoketa—a formation typically exposed along the Little Maquoketa river in Dubuque county. The type section is at Lattner's, on the D. & N. W. R. R., and 4 miles north of Peosta, on the I. C. R. R. The most prominent topographic feature in the State is the deeply crenulated escarpment of the western equivalent of the New York Niagara, stretching from the Minnesota line north of Cresco by West Union, Elkport, "Sherrill's Mound" (Dubuque county), Lattner's, and Peosta to the Mississippi at Bellevue, and forming the river-bluffs thence to Lyons. To the north the formation (generally a poorly fossiliferous dolomite abounding in cherty nodules) is thin, and its outcrop but a few miles in width; but toward the south it thickens to 350 feet or more, and its terrane widens greatly. It forms the "rapids" at Le Claire, but passes beneath the Mississippi between that town and Davenport. It is economically important by reason of its building-stone. Each of these formations (Niagara to Potsdam) is clearly differentiated, and conjointly they constitute a topographically distinct section of the State—a section in which the relief is the product of sculpture by rain and rivers during a vast period. Elsewhere the monotonous topography of the State is glacial in origin, with some post-glacial modification by hydric agencies: Here it is exclusively hydric.

To the southwestward the firm dolomites of the Niagara pass beneath the argillaceous limestones and shales of Devonian age which are usually referred conjunctively to the epoch of the New York

1. By W. J. McGee, U. S. Geologist.

2. The Fort Dodge is referred to the Cretaceous with doubt.

Chicago, Milwaukee & St. Paul Railroad.			Chicago, Milwaukee & St. Paul Railroad.		
Ms.	Prairie du Chien, & Ia. and Minn. Div.	Alt.	Ms.	Mason City and Austin Division.	Alt.
0	No. McGregor. ¹	{ 8 b. St. Peter, 633 3 a. L. Magnesian in hills, 2 b. Potsdam.	0	Mason City.	10 b. Hamilton. 1130
6	Giard.	8 b. St. Peter.	8	Plymouth.	" 1114
15	Monona.	4 a. Trenton. 1221	21	Carpenter.	"
19	Luana.	" 1182	28	Lyle.	"
26	Postville. ² 1207	4 c. Maq. & 4 b. Galena.	40	Austin, Minn.	18. Cretaceous. 1197
82	Castalia.	" " 1257	Dubuque and South-Western Railroad.		
87	Ossian.	" " 1281	0	Farley.	5 c. Niagara. 1111
48	Calmar.	4 a. Trenton. 1269	7	Worthington.	"
46	Conover. 1247	4 c. Maq. & 4 b. Gal.	14	Sand Spring.	" 933
53	Ridgeway.	5 c. Niagara.	20	Monticello.	" 800
62	Cresco.	" 1212	24	Langworthy.	"
73	Lime Springs.	" 1258	81	Anamosa.	"
78	Chester.	" 1244	88	Viola.	"
85	Leroy.	" 1298	45	Paralta.	"
(See Minnesota.)			50	Marion.	10 b. Hamilton.
Iowa and Dakota Division.			56	Cedar Rapids.	" 719
0	Calmar.	4 a. Trenton. 1269	Chicago, Council Bluffs and Omaha Line.		
6	Fort Atkinson.	" 1023	0	Sabula. ⁴	Maquoketa, 5 c. Niag.
18	Lawler.	10 b. Hamilton.	6	Elk River.	" "
27	New Hampton.	" 1166	15	Miles.	" "
35	Chicasaw.	" 1148	20	Preston.	5 c. Niagara.
38	Bassett.	"	28	Riggs.	"
47	Charles City.	" 1013	38	Delmar Junct'n.	"
50	Floyd.	" 1107	40	Elwood.	"
59	Rudd.	"	52	Oxford Junct'n.	" 730
65	Nora Springs.	"	62	Olin.	"
74	Mason City.	" 1180	74	Martelle.	"
84	Clear Lake. ³	20 a. Glacial Dft. 1237	79	Paralta.	"
95	Garner.	" 1227	87	Marion.	10 b. Hamilton.
105	Britt.	" 1230	Sioux City and Dakota Division.*		
115	Wesley.	" 1254	0	Sioux City. 1122	20 b. Loess & 18 Woodb.
126	Algona.	" 1500	8	McCook, Dak. ⁵	" 1123
150	Emmetsburg.	"	13	Jefferson.	18 b. Mid. Creta's. 1130
165	High Lake.	"	14	Davis Jc.	" 1130
173	Estherville.	"	21	Elk Point.	" 1142
162	Ruthven.	"	30	Burbank.	" 1152
175	Spencer.	"	84	Vermillion.	" 1161
187	Milford.	"	44	Meckling.	" 1167
192	Lakes Okoboji.	"	50	Gayville.	" 1170
196	Spirit Lake.	"	55	James Riv.	"
200	Sanborn.	"	61	Yankton. ⁶	" 1190
211	Sheldon.	"	14	Davis Jc.	" 1130
225	Patterson.	"	19	Joy.	"
252	Canton. ²	"	24	Westfield.	" 1148
			29	Portlandville.	" 1163

Hamilton, the precise contact being everywhere concealed by drift save at Fayette and a point on the Wapalpincon river a few miles above Central City, Linn county. The basal member of the Hamilton is a black shale which does not extend so far eastward as the medial calcareous member, but is exposed by excavations at Independence; while the uppermost member, also a dark shale or clay (typically exposed at Rockford) rarely appears along the Drift-buried western margin of the terrane. The Sub-Carboniferous formations (Burlington, Keokuk, Kinderhook, and St. Louis) cannot be discriminated geographically by reason of their deep burial beneath Drift and Loess; but all have important local exposures;—the type sections of the first two being within the State. The Burlington is noted for its crinoids which have made famous alike the city from which the formation derives its name and their local investigator, Dr. Wachsmuth; the Keokuk is equally noted for the magnificent geodes which have enriched so many collections; and both form the "Lower Rapids" which have so long vexed the spirits of Mississippi pilots and engineers. The Kinderhook yields a valuable oolitic limestone at Le Grand and elsewhere, and the St. Louis is still more important as a source of building material.

Chicago, Milwaukee & St. Paul R. R.—Cont.			Chicago, Milwaukee & St. Paul R. R.—Cont.		
Ms.	Davenport Line.	Alt.	Ms.	Dubuque Division.	Alt.
0	Davenport. ⁵ 534	10 b. Ham., 20 a. Gl. Dft	78	LaCrosse.	(See Wisconsin.)
5	Mount Joy.	" "	158	New Albin.	{ 2 b. Potsdam & 3 a.
8	Eldridge.	20 a. Glacial Drift.			L. Magnesian
17	Donahue.	5 c. Niagara.	141	Lansing. ⁹	2 b. Pots. & L. Magn.
23	Dixon.	" "	126	Harper's F'ry. ¹⁰	" "
32	Wheatland.	" "	118	Yellow River. ¹¹	" "
37	Toronto.	" "	116	No. McGregor. ¹	" "
40	Massillon.	" "			633
46	Oxford Mills.	" "	104	Clayton. ¹²	{ 3 a. L. Magnesian &
53	Wyoming.	" "			3 b. St. Peter.
69	Monticello.	" "	95	Guttenberg. ⁶⁹⁰	{ 4 a. Trenton & 4 b.
77	Hopkinton.	" "			Galena limestone.
85	Delhi.	" "	88	Turkey River.	4 a. Tren., 4 b. Galena.
89	Delaware.	" "	84	Buena Vista.	" "
94	Greeley.	" "	80	Waupeton. ¹³	" "
99	Edgewood.	" "	72	Specht's Ferry. ¹⁴	" "
106	Enfield.	" "		Peru. ¹⁵	" "
115	Brush Creek.	" "	60	Dubuque. ¹⁶	4 a. Trenton. 665
125	Fayette. ⁷ 1000	" & 10 Hamil.	54	Massey.	4 b. Galena limestone.
140	Hawkeye.	20 a. Drift, "	46	Gordon's Ferry.	{ 4 b. Galena Maquo-
149	Waucoma.	{ 5 c. Niag., 10 Ham- ilton in highlands.			keta & 5 c. Niag.
153	Jackson Junc.	20 a. Drift, 10 Ham.	38	Bellevue.	Maq. & 5 c. Niagara.
165	Calmar.	" 4 a. Tren. 1269	28	Green Island.	" " in hills.
			18	Sabula. ⁴	" " "
			2	Lyons. ¹⁷	5 c. Niagara. 680
			0	Clinton.	" 609
Racine and South-Western Division.			Volga Branch.		
11	Eldridge.	20 a. Glacial Drift.	88	Turkey River.	4 a. Tren. & 4 b. Galena
14	Long Grove.	5 c. Niagara.	108	Elkport. ¹⁸	" "
	C. & N.W. Cros'g.	" "	111	Littleport.	" "
24	De Witt.	" "	125	Volga City.	4 b. Gal., 5 c. Nia., Maq.
81	Wilton.	" "	188	Lima.	" "
87	Delmar Junct'n.	" "			
44	Maquoketa.	" "			

The southwestern third of the State is mainly occupied by the Coal Measures (generally divided into Upper, Middle, and Lower) which, notwithstanding their economic importance, have not yet been adequately studied. It is known, however, that Coal Measure outliers, containing "pockets" of coal, and of such petrographic character as to indicate that they were deposited in bays or estuaries of the coal-period sea, repose unconformably upon the Sub-Carboniferous, the Devonian, and even the Silurian formation, far beyond the normal limits of the terrane; that workable beds of coal (under existing commercial conditions) are confined in the lower member; and that the three members reach a total thickness of not less than 800 or 1,000 feet. The Carboniferous outliers find homologues in the Cretaceous sandstones designated Nishnabotna by Dr. White, after one of the rivers along which they occur; but only slight remnants of the formation they represent (unless it be the Inoceramus, the Woodbury, or both) are preserved in Iowa. It is a good working hypothesis, but nothing more, that the bedded gypsum, of which the Ft. Dodge is composed, was precipitated in one of these Cretaceous estuaries so situated as to receive little drainage and suffer rapid desiccation after the first influx of the Mesozoic ocean. The Inoceramus (named from its characteristic fossil) and the Woodbury (named from the county in which it occurs, and well exposed about Sioux City) represent regularly bedded off-shore deposits not yet finally correlated with the well-developed Cretaceous deposits of Dakota and Nebraska. So far as certainly known they occupy a limited area in extreme western Iowa.

Over the five-sixths of the State lying west and south of the Niagara escarpment the lithified sedimentary strata are over-spread by a sheet of Glacial Drift, which, in the northern-central and northwestern counties reaches a depth of 100 to 200 feet and effectually conceals the subterranean, but which attenuates eastward, southward, and westward to such a degree that stream-corrosion and artificial excavation occasionally expose the subjacent rocks. In the northern part of the State Drift-boulders frequently lie upon the surface; and within an area of 4,000 or 5,000 square miles centering in Bremer county, these superficial boulders of northern crystalline rocks reach maxima in dimensions and abundance. Diameters of fifteen to twenty feet are common; and a dozen examples sometimes occur within a radius of half a mile. In eastern, and at least parts of central, Iowa the Drift is bipartite, and the "Upper Till" and "Lower Till" constituting it are frequently separated by a "Forest Bed"; and one of the loops of the great Kettle Moraine of northern United States extends far into the northwestern portion, reaching almost or quite to Des Moines; but tripartition of the Drift inside the loop has not yet been proven stratigraphically. Inside the moraine post-glacial drainage is not yet fully developed, lakes, ponds and sloughs abound, and the topography is the same of monotonous. In extreme southern Iowa the Upper Till disappears, and is replaced by a compact, tenacious, dark clay of aqueous origin, locally known as "hard-pan," and both (as well as

Ms. Chicago, Milwaukee & St. Paul R. R. Alt.			Chicago, Milwaukee & St. Paul R. R.—Cont.		
Ms.		Alt.	Ms.	Waukon Branch. ²⁴	Alt.
194	Rock Island, Ill.	10 Hamilton. 584	0	Waukon Junc.	{ 3 b. St. Peter in hills, 3 a. L. Magn.
138	Savannah, Ill.	Maquoketa, 5 c. Niag.			{ 4 a. Trenton in hills, 3 a. L. Magn., 3 b. St.
141	Sabula, Ia. ⁴	" "	9	Waterville.	Peter in valley.
147	Elk River.	" "	23	Waukon.	4 a. Trenton.
157	Miles. ¹⁹	5 c. Niagara.	Cascade Branch.		
167	Browns.	" "	0	Bellevue.	{ 5 c. Niag. in bluffs, Maquoketa in valley
174	Delmar Junction.	" "			bottom, 20 b. Loess.
181	Elwood.	" "	11	La Motte.	20 b. Loess, 5 c. Niag.
185	Lost Nation.	" "	16	Zwingle. ²⁵	{ 20 b. Loess, 20 a. Drift, 5 c. Niagara.
198	Oxford Junction.	" 720	22	Wash'n Mills. ²⁶	20 b. Loess, "
208	Olin.	" "	25	Bernard. ²⁷	5 c. Niagara, "
215	Martelle.	{ About Junction of Niag. and Hamilton.	80	Fillmore. ²⁷	" "
228	Marion.	10 Hamilton.	86	Cascade.	5 c. Niagara, 20 a. 20 b
228	Marion.	" "	Illinois Central Railroad.		
238	Cedar Rapids.	" 719	Iowa Division.		
253	Amana. ²⁰	" "	0	Dubuque. ¹⁶	4 a. Trenton. 614
295	Sigourney. ²¹	18 d. St. Louis.	10	Julien.	Maquoketa. 845
310	Hedrick.	" "	15	Peosta.	5 c. Niagara 747
324	Ottumwa. ²² 630	18 c. Keok. & 18 d. St. L	23	Farley.	" 1111
228	Marion.	10 Hamilton.	29	Dyersville.	" 940
232	Louisa.	" "	37	Earlville.	" "
238	Covington.	" "	41	Delaware.	" 1084
248	Atkins.	" "	47	Manchester.	" 950
255	Van Horne.	" "	54	Masonville.	" 1033
260	Keystone.	" "	61	Winthrop.	" 921
267	Elberon.	20 a. Glacial Drift.	69	Independence.	10 Hamilton. 990
277	Gladstone.	" "	78	Jesup.	" 990
282	Tama City.	13 a. Kinderhook. 883	86	Raymond.	" 883
295	Pickering.	20 a. Glacial Drift.	93	Waterloo.	" 839
310	Melbourne.	" "	98	Jn. C. F. & M. R. R.	" 958
354	Des Moines. ²³	" 8 7	99	Cedar Falls.	" 958
333	Cambridge.	14 Lower Coal, etc.	109	New Hartford.	" 958
348	Madrid.	" "	118	Parkersburg.	20 a. Glacial Drift.
366	Perry.	" 977	123	Aplington.	18 a. Kinderhook. ¹¹⁷⁷
382	Bagley.	" "	132	Ackley.	" 1165
395	Coon Rapids.	" "	143	Iowa Falls.	Gl. Drift.
411	Templeton.	20 a. Glacial Drift.	149	Alden.	" 18 d. St. L. ¹⁰⁵⁴
421	Aspinwall.	" "	158	Williams.	13 d. St. Louis. 1032
435	Defiance.	" "	172	Webster City.	
446	Panama.	" "	192	Fort Dodge. ²⁸	
458	Persia.	" "			
468	Neola.	20 b. Loess.			
478	Weston.	" "			
487	Council Bluffs, Ia	" 989			
490	Omaha, Neb.	" "			

the Lower Till when they are absent) are commonly overlain by Loess, which is generally conformable to all older deposits, but in southern Iowa often merges by imperceptible gradations into the Upper Till. The Loess in the south and west is often attenuated or absent on divides and frequently eroded from valleys, and thus forms only the brows of the hills. The common phase of the Loess attains its best development along the Missouri River. In north-eastern Iowa, extending below the Niagara escarpment and overlapping the Drift margin for some miles, is another phase of the Loess, peculiar in its attitude.—It sometimes descends into valleys, but generally seeks eminences, and caps the highest ridges and divides in the region. The rivers occasionally exhibit anomalous behavior in the same region, in that they have manifestly avoided and deserted lowlands and have sought and corraded their channels in plateaus and in the axes of ridges. (See note 57.) Within the portion of the Wisconsin "Driftless Region" extending into Iowa, which is bounded by the Niagara escarpment, Glacial Drift is absent, and the prevailing superficial covering is a residuary clay formed through secular decomposition of the subjacent strata, together with a sheet of Loess and Drift debris. Alluvium occurs along all the streams of the State, and its amount varies with their volume.

1. North McGregor. St. Peter in hills.

Illinois Central Railroad.			Chicago and North-Western R. R.		
Ms.	Iowa Division—Continued.	Alt.	Ms.	Council Bluffs and Omaha Line—Cont.	Alt.
210	Manson.	20. Glacial Drift. 1245	163	Grand Mound.	5 c. Niagara. 736
218	Pomeroy.	20 a. Glacial Dft. 1244	169	Calamus.	" 721
226	Fonda.	"	173	Wheatland.	" 695
235	Newell.	"	178	Loudon.	" 733
245	Storm Lake.	"	185	Clarence.	" 841
258	Aurelia.	"	190	Stanwood.	" 863
268	Cherokee.	" 20 b. Loess. 1211	195	Mechanicsville.	" 912
283	Marcus.	" " 1469	202	Lisbon.	" 838
291	Remsen.	" " 1335	203	Mount Vernon.	10 b. Hamilton. 838
302	Le Mars.	" " 1221	210	Bertram.	" 733
319	James'.	20 b. Loess & Woodb'y.	219	Cedar Rapids.	" 744
327	Sioux City.	" " 1122	227	Fairfax.	" 784
Cedar Falls and Minnesota Branch.			234	Norway.	" 809
0	Waterloo.	10 b. Hamilton. 862	244	Blairtown.	" 855
12	Janesville.	" 892	240	Luzerne.	" 840
18	Waverly.	" 942	254	Belle Plaine.	" 840
27	Plainfield.	" 926	260	Chelsea.	20 a. Glacial Drift.
35	Nashua.	" 975	270	Tama.	13 a. Kinderhook. 832
46	Charles City.	" 1012	277	Montour.	" 868
52	Floyd.	" 1107	280	Le Grand.	" 953
63	Osage.	" 1178	283	Quarry.	" 899
67	West Mitchell.	"	288	Marshall. ⁸⁰	13 c. Keokuk. 893
72	St. Ansgar.	" 1179	296	Lamoille.	14 a. Low. Coal Mres. 1036
80	Mona.	" 1203	303	State Centre.	" 1059
Chicago and North-Western Railroad.			310	Colo.	" 1017
Clinton and Anamosa Line.			317	Nevada.	13 d. St. Louis. 936
0	Clinton.	5 c. Niagara. 617	326	Ames.	14 a. Lower Coal.
3	Lyons. ¹⁷	" 617	330	Ontario.	"
10	Almont. ²⁹	" Maquoketa. 692	335	Midway.	" 1155
17	Bryant.	5 c. Niagara. 802	340	Boone.	" 907
25	Charlotte.	" 711	346	Moingona.	" 1109
33	Delmar Junct'n.	" 837	352	Ogden.	" 1041
38	Maquoketa.	" 718	357	Beaver.	" 1055
44	Nashville.	" 739	363	Grand Junction.	" 1071
47	Baldwin.	" 744	370	New Jefferson.	20 a. Glacial Drift.
50	Monmouth.	" 791	379	Scranton.	" 1240
57	Onslow.	" 936	388	Glidden.	" 1439
64	Amber.	" 956	396	Carroll.	"
71	Anamosa.	" 844	406	Arcadia.	"
Council Bluffs and Omaha Line.			408	West Side.	"
0	Chicago.	(As before.)	415	Vail.	20 b. Loess, 20 a. Gl. Dft.
138	Clinton.	5 c. Niagara. 609	424	Denison.	" " 1192
143	Camanche.	"	433	Dowville.	" "
147	Low Moor.	" 657	441	Dunlap.	" "
152	Malone.	"	450	Woodbine.	" "
157	De Witt.	" 690	458	Logan. ⁹²⁸	14 c. Up. or 14 b. Mid. Cl.
			467	Mo. Valley Jc. ³¹	" " 1022
			482	Crescent. ³¹	" " 1209
			488	Council Bluffs. ³¹	" " 989

2. *Postville.* Galena and Maquoketa, with Niagara outlier to south and Trenton exposures to north.

3. *Clear Lake to Canton.* The road traverses a plain of Glacial Drift, characterized by the lakes, marshes and nascent drainage system of the region circumscribed by the Terminal Moraine. The drift is of great thickness and the subterranean wholly unknown.

4. *Sabula.* Maquoketa in slopes, Niagara in hill-tops.

5. *McCook.* One of the finest exposures of Loess in the Missouri basin extends along this Railway from Sioux City to McCook.

6. There are no rock exposures on this division, and the author of this chapter is not responsible for the formations here given.

7. *Fayette.* The contact between Devonian and Silurian rocks, seen only at one other locality in the State (near Central City, Linn Co.), is well exhibited here in a natural exposure in the north-western part of the town.

Chicago and North-Western R. R.—Cont.			Chicago and North-Western R. R.—Cont.		
Ma.	St. Paul and Minneapolis Lines.	Alt.	Ma.	Eagle Grove and Hawarden Line.	Alt.
6	Des Moines. ²³	14 a. Lower Coal. 824	368	Eagle Grove.	20 a. Drift. 1139
7	Saylor.	" 984	377	Thor.	" 1171
8	Trent.	"	386	Dakota City. ²⁴	18a. Kind'k. Drift. 1144
11	Ankeny.	" 1024	391	Rutland.	" ? " 1147
14	Pelton.	"	398	Bradgate.	20 a. Drift. 1144
18	Polk City.	"	404	Rolfe Junction.	"
21	Ulm.	"	413	Havelock.	20 a. Glacial Dft. 1251
25	Sheldahl.	" 1060	421	Lawrence.	" 1333
31	Kelley.	"	428	Marathon.	" 1414
37	Ames.	13 d. St. Louis. 943	437	Sioux Rapids.	" 1283
44	Gilbert.	" 20 a. Dft. 1154	443	Lime Grove.	" 1276
50	Story.	" " 1199	450	Peterson.	" 1257
53	Randall.	" " 1207	455	Waterman Sdg.	"
59	Jewell.	20 a. Drift. 1078	459	Sutherland. 1449	" and 20 b. Loess.
66	Kamrar.	" 14 c. Low. Coal.	479	Granville.	" 1469
73	Webster City.	" 13 d. St. L. 1066	488	Alton.	" 1328
81	Woolstock.	20 a. Drift. 1109	499	Maurice.	" 1378
88	Eagle Grove.	" 1139	514	Hawarden.	" 1308
94	Thrall.	" 1163	(Continued in Dakota.)		
100	Renwick.	"	Iowa and South-Western Railway.		
108	Whitman.	" 1189	0	Carroll. 1247	Drift. 14 c. Low. Coal.
117	Irvington.	" 1176	17	Manning.	" " 1149
121	Algona.	" 1228	25	Gray.	" " 1175
131	Burt.	" 1178	35	Audubon.	" " 1123
137	Bancroft.	" 1139	17	Manning.	" " 1149
Maple River R. R. Branch. ²⁵			29	Irwin.	Loess, Drift. " 1089
0	Maple River Jc.	20 a. Glacial Dft. 1089	35	Kirkman.	" " 1054
7	Breda.	" 1193	Iowa, Dakota and Minnesota Division.		
17	Wall Lake. ³³	" 1059	270	Tama. 839	Loess in plateau to N. W., 13 a. Kinderhook, Drift.
27	Odebolt. 1188	" and 20 b. Loess.	273	Toledo. 873	
38	Ida Grove.	Dft. in valley " 1050	281	Garwin. 919	Loess in plateau to the West, Drift, 14c. Low. Coal in vicinity, 13 a. Kinderh'k.
45	Battle Creek.	" " 1023	298	Conrad. 1029	
54	Danbury.	" " 984	306	Whitten. 1061	
60	Mapleton.	" " 939	310	Eldora Junc. ⁵⁷	20 Alluvium. " 941
Sac City Branch ²²			314	Lawn Hill.	20 a. Drift, 14 c. L. Cl. " 1309
0	Wall Lake. ³³	20 a. Glacial Dft. 1059	329	Radcliffe.	" " 1104
13	Sac City.	" 1104	336	Ellsworth.	20 a. Drift. " 1078
21	Early.	" 1144	339	Jewell Junction.	" " 14 c. L. Cl. 1141
29	Schaller. 1207	" and 20 b. Loess.	354	Stratford.	" " 1109
36	Galva.	" " 1099	364	Dayton.	" " 1158
44	Holstein.	" " 1254	375	Gowrie.	" " 1269
52	Cushing.	" " 1212	380	Franklinville.	" " 1269
57	Correctionville.	" " 844	397	Lake City.	" " 1269
70	Kingsley.	" " 1047			
Tipton Branch.					
190	Stanwood.	{ 5 c. Niag. over- 863			
194	Walden.	" lain by Dft.			
198	Tipton.	" " & Loess.			

8. *Davenport*. Hamilton in valleys and hillsides, and ferruginous sandstone of the Lower Coal on eminences, overlain by Glacial Drift, Forest Bed and Loess. The brown sandstone occurs also at Muscatine, Iowa City, Eldora, and elsewhere. It is referred to Lower Coal with doubt. It occurs in isolated outcrops and was probably deposited in independent basins, as indicated by Hall in 1866.

9. *Lansing*. St. Peter in hills.

10. *Harper's Ferry*. St. Peter in hills.

11. *Yellow River*. St. Peter in hills.

12. *Clayton*. St. Peter, with Trenton on hills.

13. *Waupeton*. Trenton and Galena, with Maquoketa and Niagara in hills.

Chicago, Rock Isl'd and Pac. R. R. Alt.			Chicago, Rock Isl'd and Pacific R. R.—Cont.		
			Ms. Indianola and Winterset Branch. Alt.		
Chicago.	(As before.)		0 Des Moines. ²³	14 a. Lower Coal.	808
renport. ⁵⁷⁸	{ 20 a. Gl. Dft., 20 b. Loess, 14 a. Low. Cl. 10 Hamilton.		8 Avon.	"	
leott.	20 a. Glacial Drift.	733	10 Carlisle.	"	
ton.	{ 5 c. Niagara. 20 a. Glacial Drift.	753	15 Somerset Junc.	14 b. Middle Coal.	
lton.	5 c. Niagara.	672	18 Somerset.	"	
scow.	10 Hamilton.	652	21 Indianola.	"	
Missa.	"		15 Somerset Junc.	"	
st Liberty.	"	666	21 Spring Hill.	"	
wney.	"	683	25 Lathrop.	14 c. Upper Coal Mrs.	
ra City. ³⁵	"	671	30 Bevington.	"	
ford. ⁵⁶	"	720	34 Patterson.	"	
mestead. ³⁷	"	866	42 Winterset. ⁴³	"	
rengo. ⁸⁸	"		Oskaloosa Branch.		
stor. ⁸⁰⁶	20 a. Gl. Dft., 20 b. Loess		0 Washington.	13 d. St. Louis.	738
oklyn. ⁸⁹	20 a. Gl. Drift.	886	15 Keota.	14 a. Lower Coal.	
colm.	"		20 Harper.	"	
nnell. ⁴⁰	"	1011	28 Sigourney. ²¹	" 13 d. St. L.	
llogg.	14 a. Lower Coal.	839	36 Delta. ⁴⁴	"	
wton.	"	958	43 Rose Hill. ⁴⁵	"	
fax.	13 d. St. Louis.	783	52 Oskaloosa.	{ 14 a. Lower Coal. Loess. Drift.	
chellsville.	14 a. Lower Coal.	966	58 Knoxville Junc.	Drift, 14 a. L. Cl.	
Moines. ²³	"	800	63 Olivet.	"	
neville.	"		68 Harvey.	" " 13 d. St. L.	
Soto.	"		78 Knoxville.	" " "	
rlham.	14 c. Upper Coal.		Keokuk and Des Moines Division.		
xter.	"	1146	0 Des Moines. ²³	14 a. Lower Coal.	799
art.	20 a. Glacial Drift.		24 Prairie City.	"	
thrie.	"	1269	35 Monroe.	"	
sey.	"	1226	47 Pella. ⁴⁷	14 a. Lower Coal.	
air.	"		62 Oskaloosa.	" [St. L.	
ita.	"		71 Eddyville. ⁴⁸	" 13 c. Keo. 13 d.	
lantic.	"		86 Ottumwa. ²²	" " "	
oca.	20 b. Loess, 20 a. Gl. Dft.		98 Eldon.	" " "	
elby.	"		116 Summit.	13 c. Keokuk.	1084
ola.	"		123 Bentonsport.	"	
uncil Bluffs.	"	989	126 Bonaparte.	"	
South-Western Division.			132 Farmington.	" and 14 b.	
ilton.	5 c. Niagara.	672	137 Croton.	"	
ascatine. ⁴¹	"	544	147 Sand Prairie.	"	
owa.	13 a. Kinderhook.		162 Keokuk.	13 c. Keok. & 13 a. Kind.	
edonia.	"		Audubon Branch.		
lumbus Junc.	"	888	0 Atlantic.	{ Drift, Loess in val-	
nsworth.	13 d. St. Louis.	738	1 Audubon Junc.	leysides, Subterranean	
ashington.	"		12 Brayton.	probably 14 c. U. Cl.	
ighton. ⁴²	"		16 Exira. ⁴⁶	18 Nishnabotna near	
irfield. ⁵¹	"	767	26 Audubon.	to South-east. [Cl.	
bertyville.	20 a. Glacial Drift.			" " ov. 14 b. Mid.	
don.	13 c. Keokuk.		Carson and Harlan Branch.		
lknep.	14 a. Lower Coal.	857	1 Carson.	{ Loess and Drift	
ionville.	"		18 Avoca.	over 14 c. Upper	
ntreville.	"	1013	1 Harlan Junction.	Coal.	
ymour.	14 c. Up. or 14 b. M. Cl.		13 Harlan.	Loess and Drift.	

(Continued in Missouri.)

Specht's Ferry. Trenton and Galena, with Maquoketa and Niagara in hills.*Peru.* Trenton and Galena, with Maquoketa and Niagara in hills.*Dubuque.* Trenton in river bed, Galena in hills, Maquoketa on eminences, overlaid by Loess.

Chicago, Rock Island and Pac. R. R.—Cont.			Chicago, Burlington and Quincy R. R.		
Ms.	Monroe Branch.	Alt.	Ms.	Iowa Division—Continued.	Alt.
0 Newton.	14 a. Low Coal.		241 Red Oak. 1033	{ 14 c. U. or 14 b. M. C. Nish. & 20 b. Loess.	
10 Reasnor. ⁴⁹	"		255 Hastings.	20 b. Loess.	
17 Monroe.	"		261 Malvern.	{ 14 b. or c. U. or Mid. Coal & 20 b. Loess.	
Guthrie Branch.			271 Glenwood.	{ 14 c. Up. or Mid. 979 Coal & 20 b. Loess.	
0 Menlo.	D't over 14 c. Up. Cl. ?		275 Pacific Junc. ⁵²	14 c. U. or Mid. Cl. 920	
6 Glendon.	" Nish'botna.		279 E. Plattsmouth.	River mud. 924	
15 Guthrie Centre.	" "		Des Moines, Chariton and St. Joseph Branch.		
South-Western Division.			0 Indianola.	14 a. L. & 14 b. Mid. Cl.	
183 Davenport. ⁵	As before.		5 Ackworth.	" "	
192 Buffalo.	{ Fossilifer's 10 Ham-		11 Milo.	" "	
197 Montpelier.	ilton in valley, 14 c.		19 Lacona.	" "	
203 Fairport.	{ Lower Coal in hills.		26 Oakley.	" "	
211 Muscatine. ⁴¹	{ Loess, D't, 10 Ham- ilton, 14 c. L. Coal.		30 Indianola Junc.	" "	
Chicago, Burlington and Quincy R. R.			30 Chariton. 1030	14 a. Lower Coal Mrs.	
Iowa Division.			44 Derby.	" [Mrs	
0 Burlington. ⁵⁰	13 b. Burlington. 526		50 Humeston.	14 b. U. or 14 c. Mid. Cl.	
9 Middletown. 725	20 a. Gl. Dft., 20 b. Loess		56 Garden Grove.	" "	
13 Danville. 715	"		69 Leon. ⁵⁴	" " 1035	
19 New London.	"		190 Creston.	" "	
28 Mt. Pleasant. 725	13 c. Keok. & 13 d. St. L.		207 Lenox.	" "	
35 Rome.	13 b. Burl. & 13 c. Keok.		225 Bedford.	" "	
42 Glendale.	14 b. Lower Coal. 745		234 Hopkins.	" "	
50 Fairfield. ⁵¹	13 d. St. Louis. 767		241 Red Oak. 1033	{ 14 c. U. or 14 b. Mid. Coal. Nishnabotna	
55 Whitfield.	" 677		254 Essex.	20 b. Loess. 996	
62 Batavia.	14 a. Lower Coal. 640		269 Shenandoah.	" 979	
69 Agency.	" 801		266 Farragut.	" 963	
75 Ottumwa. ²³	13 c. Keokuk. 680		271 Riverton.	" 931	
83 Chillicothe.	" 645		280 Hamburg.	" 913	
88 Dudley.	" & 13 d. St. L.		291 Nebraska City.	River mud.	
91 Frederic. 735	20 Gl. Dft. & 14 a. L. Cl.		Albia and Des Moines Branch.		
100 Albia.	" " 945		0 Albia.	Drift over 14 a. L. Cl.	
108 Tyrone.	" " 819		9 Lovilla.	" "	
114 Melrose.	" " 853		14 Bussey.	" 13 d. St. L.	
122 Russell.	" " 1017		19 Tracey. ⁵³	" "	
180 Chariton.	" " 1030		25 Durham.	Loess & Dft. over "	
189 Lucas.	14 c. U. or 14 b. Mid. C.		28 Flaglers.	Drift over 14 a. L. Cl.	
146 Woodburn.	14 c. Up. & Mid. Coal.		33 Knoxville.	{ Loess, Drift, 14 a. L. Coal, 13 d. St. Louis.	
156 Osceola.	" 1123		37 Donnelly.	Drift over 14 a. L. Cl.	
166 Murray.	" 1133		43 Pleasantville.	" "	
180 Afton.	"		49 Swan.	" "	
190 Creston.	" 1220		68 Des Moines. ²³	14 a. Lower Coal. 800	
195 Cromwell.	" 1127				
211 Corning.	"				
215 Brooks'.	"				
225 Villisca.	"				
233 Stanton.	" 1004				

17. Lyons. The Maquoketa passes beneath the Niagara a mile north of Lyons, where the contact is well exhibited in an artificial cutting.

18. Elkport. Trenton in valley, Galena in first bluff, Maquoketa in terrace, and Niagara in second bluff.

19. Miles. Maquoketa in slopes, Niagara in hills.

20. Anana. Hamilton, locally overlain by Lower Coal ferruginous sandstones.

21. St. Louis. St. Louis, with Lower Coal in hills.

22. Ottumwa. Keokuk, with St. Louis and Lower Coal on hills to north and south.

23. Des Moines. The Loess of Des Moines reposes on Drift in normal relation, but is in turn overlain by a newer sheet of Drift. Such superposition is unknown elsewhere. *Vide Am. Jour. Sci.* 3d, XXIV., 1882. 202-23.

Chicago, Burl. and Quincy R. R.—Continued.

Sta.	Branches.	Alt.
0 Villisca.	14 b. U. Cl., Loess, Drift.	
1 Clarinda Junct.	" " "	
16 Clarinda.	" " "	
36 Burl'ton Jc., Mo.	" " "	
0 Creston.	Drift, 14 b. Mid. Coal.	
15 Orient.	" " "	
80 Fontanelle.	" " "	
0 Bethany Junct.	{ Loess (sometimes absent). Drift, 14 c. Upper Coal.	
11 Kellerton.		
22 Mt. Ayer.		
29 Delphos.		
44 Grant City.		
0 Red Oak.	{ 14 c. Up. Coal, Nish- nab'na & 20 b. Loess. Loess, Drift, (some- times absent), 14 c. Upper Coal.	
7 Stannet.		
12 Elliot.		
18 Griswold.		
0 Hastings.	{ 20 b. Loess over 14 c. Upper Coal.	
9 Henderson.		
13 Macedonia.		
16 Carson City.	{ Loess, Drift, (s'times absent), 14c. Up. Cl.	
0 Hastings.	{ 20 b. Loess over 14 c. Upper Coal, Drift sometimes exposed at base of Loess.	
12 Randolph.		
18 Anderson.		
27 Sidney.		
0 Clarinda.	{ Loess, Drift, 14 c. Upper Coal.	
18 Northboro.		
0 Burlington.	{ Loess, Drift, 18c. 526 Keok., 18 b. Burl. Loess, D'ft, 18c. Keo. in hills, Allu. in val. Loess, Drift.	
11 Wever.		
19 Ft. Madison.		
25 Vile.		
82 Montrose.	{ Alluvium, Loess, Drift & 18 c. Keok.	
87 Ballinger.		
88 Sandusky.		
43 Keokuk.	{ Loess, Drift, 13d. 501 St. L., 18c. Keokuk.	

Chicago, Burl. and Kansas City R. R.

0 Burlington. 50	18 b. Bur. 18c. Keo. 526
19 Fort Madison.	" 512
25 Vile.	18 c. Keokuk. 548
31 Franklin.	" 702
33 Donaldson.	20 a. Glacial Drift. 707
36 Warren.	18 c. Keokuk. 708
44 Farmington.	" 13 d. St. L. 571
50 Willits.	14 a. Lower Coal. 604
55 Mount Sterling.	" 649
63 Cantril.	" 776
69 Milton.	" 806
75 Pulaski.	" 840
85 Bloomfield.	" 864
99 Moulton.	" 994
108 Caldwell.	" 887
113 Cincinnati.	" 1087
118 Mendota, Mo.	" 885
122 Howland, " 983	14c. Up. or 14 b. Mid. Cl.
128 Unionville, "	(Con. in Mo.) 1062

**Wabash, St. Louis and Pacific Railroad,
St. Louis and Des Moines Branch.**

0 St. Louis.	(See Missouri.)
229 Glenwood, Mo.	979
230 Glenwood Junct.	979
252 Centreville.	14 a. Lower Coal. 1018
266 Moravia.	{ " overlain by Gl. Drift.
279 Albia.	" 945
298 Bussey.	18 d. St. Louis "
298 Tracy. 55	"
317 Dunreath.	14 a. Lower Coal.
828 Runnells.	"
843 East Des Moines.	"
844 Des Moines. 23	{ " overlain by 20 b. Loess & 20 a. Glacial Drift. 807
0 Centreville.	14 b. Lower Coal. 1018
7 Sedan.	" 827
11 Dean.	" 825
15 Hamilton.	" 987

24 *Waukon Branch.* Entirely in the "Driftless Area." The superficial detritus is residuary clays, sands, and alluvium.

25 *Zwingie.* Attenuated eastern margin of Glacial Drift.

26 *Washington Mills.* Maquoketa a few feet below level of creek.

27 *Bernard, Filmora.* Between these stations lies an insulated basin of Drift, completely surrounded by Loess.

28 *Fort Dodge.* St. Louis overlain by Fort Dodge resting on Lower Coal in hills.

29 *Almont.* Maquoketa in slopes, Niagara in hills.

30 *Marshall.* St. Louis? Lower Coal in eminences. Remarkable crinoid bed near here.

31 *Mo. Valley Junction.* Glacial Drift in valleys. Loess on uplands.

32 *Maple River and Sac City Branches* traverse an area over which the Glacial Drift is of considerable thickness and overlain by Loess, gradually thickening westward from an irregular eastern margin generally coinciding approximately with the Mississippi-Missouri watershed.

33 *Wall Lake* is named from the adjacent lake, which is in part surrounded by a natural wall of rock, formed by the long continued pushing shoreward of the boulders lying upon its shallow bottom by the expansion of the ice in which they become bedded each winter.

34 *Dakota City.* From near Dakota City to the Big Sioux River this railway traverses a heavily drift-mantled area, and the subterranean is wholly unknown empirically. The Sub-Carboniferous probably extends many miles. Northwest of Dakota there may be remnants of the Coal Measures. The Inoceramus and Woodbury are probably developed towards the state line where, too, the red quartzites of the Sioux doubtless lie beneath the Drift and Loess.

35 *Iowa City.* Hamilton in city, and Lower Coal sandstones in hills to northward, overlain by Glacial Drift and Loess. Locality of "Iowa City Marble."

36 *Oxford.* Hamilton with Lower Coal sandstones in hills.

Ms. Wabash, St. L. and Pac. R. R.—Con. Alt.			Sioux City and Pacific Railroad.			
269	Keokuk.	480	{ 13 c. Keok. overlain by 20 b. Loess.	0	Sioux City. ¹¹²²	20 b. Loess & 18 Woodb
274	Alexandria, Mo.			9	Sergeant's Bluffs.	" " 1008
281	Wayland, "			22	Sloan.	" " 1019
287	Clark City, "			38	Onawa.	Alluvium & Loess. ¹⁰⁶⁴
293	Luray, "			58	River Sioux.	" " 1053
306	Arbela, "			60	Mondamin.	" " 1038
314	Memphis, "			66	Modale.	" " 1029
325	Downing, "			71	California Junc.	" " 1024
335	Lancaster, "			77	Missouri Valley.	" " 1032
388	Glenwood Junc.					
352	Sedan.	14 a. Lower Coal. ⁵²⁷		Kansas City, St. Joseph and Council Bluffs.		
359	Centreville.	" " 1013		1	Council Bluffs.	20 b. Loess. ⁹⁸⁹
387	Corydon. ¹⁰⁹²	14c. Up. or 14b. Mid. Cl.		6	Traders' Point.	20. Alluvium. ⁹⁷⁴
400	Humeston.	" "		14	Pacific.	" " 961
414	Weldon.	" "		17	Pacific Junc. ⁵²	" " 960
428	Grand River.	" "		20	Haney's. ⁵⁶	" " 955
453	Goshen.	" "		25	Bartlett.	" " 949
484	New Market.	" "		30	McPaul.	" " 940
492	Clarinda. ¹⁰⁶⁹	" " overlain by 20 b. Loess.		34	Percival.	" " 933
500	Yorktown.	" " overlain by 20 b. Loess. ⁹⁷⁹		40	E. Nebraska City.	" " 923
513	Shenandoah.	" " overlain by 20 b. Loess. ⁹⁸⁹		51	Hamburg.	" " 913
535	Malvern.	" " overlain by 20 b. Loess. ⁹⁸⁹		(Continued in Missouri.)		
563	Council Bluffs.	" " overlain by 20 b. Loess. ⁹⁸⁹		Des Moines and Fort Dodge Railroad.		
	Omaha, Neb.	20 b. Loess.		0	Des Moines. ²³	14 a. Low. Cl. Mrs. ⁸⁰⁷
Des Moines Division (Narrow Gauge).				8	Ashewa.	" " 905
0	Des Moines. ²³	(As before.) ⁵⁰⁷		15	Waukee.	" " 1048
15	Waukee.	14 a. Lower Coal. ¹⁰⁴⁹		21	Dallas Centre.	" " 1085
22	Adel.	" " 901		27	Minburn.	" " 1092
31	Redfield. ⁹⁶⁸	" and 18 Nish. ¹⁰⁷⁴		34	Perry.	" " 977
43	Panora.	" " 1074		42	Rippey.	" " 1080
53	Herdon.	20 a. Glacial Drift.		50	Grand Junction.	" " 1055
66	Jefferson.	" "		59	Paton.	" " 1116
79	Churdan.	" "		67	Gowrie.	" " 1184
87	Eads.	" "		73	Callender.	" " 1159
98	Rockwell City.	" "		82	Tara.	" " 1159
115	Fonda.	" "		88	Fort Dodge. ²³	{ 13 d. St. Louis, ¹⁰¹² 18 d. Fort Dodge.
Chic., St. Paul, Minneap. and Omaha R'y.				82	Tara.	20 a. Drift, 14 a. L. Cl. ?
St. Paul, Omaha and Kansas City.				89	Clare.	20 a. Drift.
0	Sioux City. ¹¹²²	20 b. Loess & 18 Woodb.		100	Gilmore.	" "
8	James.	20 b. Loess.		108	Rolfe.	" 13 a. Kind'h'k ?
25	LeMars.	" " 1221		114	Plover.	" "
30	Seney. ¹²²¹	" & 20 a. Gl. Dft. ¹²⁰²		119	Mallard.	" "
42	East Orange.	20 a. Gl. Drift. ¹³³⁸		130	Ayrshire.	" "
50	Hospers.	" " 1406		137	Ruthven.	" "
58	Sheldon.	" " 1442				
67	St. Gilman.	" " 1509				
74	Sibley.					
92	Worthington.	(See Minnesota.)				

37. *Homestead.* Hamilton with Lower Coal sandstones in hills.

38. *Marengo.* Hamilton with Lower Coal sandstones in hills.

39. *Brooklyn.* Glacial Drift with St. Louis? in artificial exposures.

40. *Grinnell.* About the undetermined eastern margin of the Lower Coal.

41. *Muscatine.* Hamilton with Lower Coal sandstones on hills, overlain by Glacial Drift and Loess. From Davenport to Muscatine the Mississippi has corraded its channel through one of the Carboniferous outliers (ferruginous sandstone, with pockets of coal) characteristic of eastern Iowa (cf. Hall, Geol. Ia., 1858. Pt. 1, 44, 120 *et seq.*) and into Hamilton strata which decline from perhaps 100 feet above the river at Davenport to its level just below Muscatine. The stratified rocks are overlain by Drift, generally capped by Loess, which is typical in Muscatine.

42. *Brighton.* St. Louis, with Lower Coal to southward in hills.

43. *Winterset.* Lower Coal in river, Upper and Middle Coal generally.

44. *Delta.* St. Louis, with Lower Coal in hills.

Central Iowa Railway.**			Central Iowa Railway—Continued.		
Ms.		Alt.	Ms.		Alt.
0	St. Louis.	(See Missouri.)	0	Marshalltown.	{ 18 c. Keok., 18 d. St. Louis, partly overlain by D'ft & Loess.
176	Keokuk.	18 c. Keokuk. 501	4	Minerva Junct.	Drift and Alluvium.
258	Ottumwa. ³⁹	" " 530	11	Minerva.	Drift over 14 a. L. Cl. ?
269	Eddyville. ⁴⁰	" 18 d. St. L. 573	18	Bromley.	" "
278	Givin.	" " 550	17	St. Anthony.	" "
278	Oskaloosa.	14 a. Lower Coal. 550	22	Zearing. ⁵⁹	" "
291	New Sharon.	" " 577	38	Roland.	" "
299	Searsboro.	18 d. St. Louis. 510	89	Story City.	" 18 d. St. Louis.
811	Grinnell. ⁴⁰	20 a. Glacial Dft. 1011	State Center Branch.		
822	Gilman.	18 c. Keokuk. 1035	0	Grinnell. ⁴⁰	20 a. Glacial Drift.
827	Dillon.	" " 598	6	Newburg.	20 a. D'ft ov. 14a. L. C.?
836	Marshalltown. ⁶⁶	18c. Keo. & 18 d. St. L.?	24	State Center Jct.	" "
843	Albion.	20 a. Glacial Drift. 568	33	State Center.	" "
849	Liscomb.	" " 1078	Newton Branch.		
854	Union. ¹⁰¹³	14a. L. Cl., ferruginous ss. 1158	0	New Sharon.	{ 14 a. Low. Coal, 550
868	Eldora.	" " 1061	14	Lynnville.	{ generally concealed by Drift. 558
867	St'mboat Rock. ⁵⁷	{ 18c. Keo., 18a. Kind. 1176	80	Newton.	
874	Abbott.	20 a. Glacial Drift. 1176	Montezuma Branch.		
879	Ackley.	" " 1177	0	Grinnell. ⁴⁰	20 a. Drift. 1011
884	Franklin.	18 a. Kinderhook. 1193	10	Ewart.	" "
889	Geneva.	20 a. Glacial Dft. 1181	17	Montezuma.	{ " Loess ov. East-ern margin 14a. L. C.
895	Hampton.	" " 1240	Burlington, Cedar Rapids and Northern Railroad.		
404	Chapin.	" " 1246	0	Burl'gton. ⁵⁰	18 b. Burl. & 18 c. Keo.
412	Rockwell.	10 Hamilton. 1219	9	Latty.	20 a. Glacial Drift.
424	Mason City.	10 b. " 1180	12	Sperry.	" 747
98	W. Keithsburg. ⁶⁷	20 Alluvium.	15	Kossuth.	" 769
100	Elrick.	" " over under term'd Sub-carb. strata.	20	Linton.	" 835
108	Morning Sun.	Gl. Dft. "H'd-pan."	23	Morning Sun.	18 a. Kinderhook. 573
119	Winfield.	" " " "	29	Wapello.	20 a. Glacial Drift.
126	Olds.	" " " "	35	Long Creek.	" 585
132	Wayland.	" " " "	41	Columbus Junc.	" 606
135	Coppack.	" " ? " "	44	Port Allen.	" 638
142	Brighton. ⁴²	18d. St. L., 14a. in hills	55	Nichols.	10 Hamilton. 638
147	Clay.	20 Gl. Drift.	61	West Liberty.	" 666
151	Richland.	" over 14 a. L. Cl.	67	Centredale.	" 715
169	Hedrick.	" " " "	70	West Branch.	" 708
176	Fremont.	" " ? " "	78	Oasis.	" 790
182	Wright.	" " ? " "	77	Morse.	" 753
189	Oskaloosa.	14 a. Lower Coal. 550	82	Solon.	" 784
19	Hickory.	{ Loess, Drift ov. 18 c. Keok. & 18 d. St. L.	89	Ely.	" 731
23	Maxon.	Loess, D'ft ov. 14a. L. C.	Belmond Branch.**		
24	Albia.	" " " "	0	Belmond.	{ Drift over undetermined Sub-Carboniferous strata.
Belmond Branch.**			14	Lattimer.	
0	Belmond.	{ Drift over undetermined Sub-Carboniferous strata.	22	Hampton.	

45. *Ross Hill.* St. Louis, with Lower Coal in hills.

46. *Exira.* About the northern margin of Upper Coal.

47. *Pella.* St. Louis in valleys and south of town.

48. *Eddyville.* Keokuk, with St. Louis and Lower Coal in adjacent hills.

49. *Reasnor.* It is probable that the Chicaqua (Skunk) River, crossed between Reasnor and Monroe, cuts down to the Sub-Carboniferous.

50. *Burlington.* Burlington, with Keokuk in hills overlain by Glacial Drift and Loess.

51. *Fairfield.* St. Louis, with Lower Coal in hills to northward.

52. *Pacific Junction.* Upper or Middle Coal capped by Loess in hills to eastward.

53. *Des Moines, Chariton and St. Joseph Branch of C. B. & Q.* probably passes a short distance east of and parallel with the eastern limit of the Upper Coal, sometimes on the Middle and sometimes on the Lower, sometimes, possibly, over salients or outliers of Upper Coal. The stratified rocks are generally deeply covered by Drift, sometimes overlain by Loess.

54. *Loon.* Streams have rarely cut down to Middle Coal.

Burlington, Cedar Rapids and Northern Railroad—Continued.			Burl., Cedar Rapids and North. R. R.—Coa Pacific Division.				
Ms.		Alt.	Ms.		Alt.		
97	Cedar Rapids.	10 b. Hamilton.	744	0 Cedar Rapids.	10 Hamilton.	718	
101	Linn.	"	741	10 Palo.	"	741	
107	Palo.	"	741	14 Shellsburg.	"	744	
111	Shellsburg.	"	744	23 Vinton.	"	800	
120	Vinton.	"	800	30 Garrison.	"	849	
128	Mount Auburn.	"	852	39 Dysart.	"	936	
134	La Porte.	"	802	47 Traer.	"	906	
150	Waterloo.	"	862	59 Reinbeck.	"	916	
156	Cedar Falls.	"	844	69 Grundy Centre.	"	966	
160	Norris.	"		78 Wellsburg.	20 a. Glacial Drift.		
164	Finchford.	"		85 Cleves.	"		
171	Shell Rock.	"	911	87 Abbott Crossing.	"		
178	Clarksville.	"	914	97 Iowa Falls.	18 a. Kinderhook.	644	
189	Greene.	"	943	107 Carleton.	20 a. Glacial Drift.		
195	Marble Rock.	"	992	119 Galtville.	"		
202	Rockford.	"	1011	126 Clarion.	"		
210	Nora Junction.	"	1052	136 Goldfield.	"		
215	Rock Falls.	"	1094	144 Hardy.	"		
219	Plymouth.	"	1114	153 Livermore.	"	1184	
250	Lyle.	"	1105	158 Bode.	"		
261	Austin.	"		169 West Bend.	"		
Decorah Division.			185 Emmetsburg.	"			
0	Cedar Rapids.	10 b. Hamilton.	744	195 Graettinger.	"		
4	Linn.	"		201 Wallingford.	"		
18	Center Point.	"	809	207 Estherville.	"		
25	Walker.	"	880	214 Superior.	"		
39	Independence.	"	1111	228 Spirit Lake, Minn.	"		
58	Oelwein.	"	1039	235 Lake Park.	"		
60	Maynard.	"	1096	244 Round Lake.	"		
69	Donnan.	"		253 Worthington.	"		
74	West Union.	"	886	Belmond Division.			
78	Brainard.	5 c. Niag. & Maq'keta.		0 Dows.	{ 20 a. Heavy Drift, over Sub-Carbonif- erous.		
81	Elgin. ⁶⁰	4 a. Trenton.	832	15 Belmond.			
89	Clermont.	"	856	41 Madison.			
98	Postville. ²	4 c. Maq. & 4 b. Gal.	1207	Clinton Division.			
Muscatine Division.			0 Elmira.	Drift, 10 Hamilton.			
0	Muscatine. ⁴¹	10 b. Hamilton.	844	6 Plato.	Loess, Drift, 5 c. Niag.		
11	Cedar River.	"		16 Tipton.	" " "		
13	Adams.	"	608	25 Bennett.	" " "		
16	Nichols.	"	628	37 Dixon.	Loess, " "		
23	Lone Tree.	"	718	45 Noels.	" " "		
26	River Junction.	"		53 McCausland.	All., Loess, Drift, Nia.		
31	Riverside. ⁶¹	"	631	58 Folletts.	Alluvium, 5 c. Niag.		
37	Kalona.	Loess, D'ft, 13a. Kind.?		69 Clinton.	{ Loess in hills, Allu- vium in valley, 5 c. Niagara.		
53	Kinross.	" " "		Iowa City Division.			
66	Keswick.	" " "		0 Elmira.	Drift, 10 Hamilton.		
70	Thornburg Junc.	" " 14a. L. Coal.		3 Graham.	" "		
76	What Cheer.	" " "		9 Iowa City. ³⁵	Loess, Drift, "		
79	Barnes City.	" " "		18 Iowa Junction.	" " "		
88	Montezuma.	" " ?					

55. Tracey. St. Louis, with Lower Coal on hills to westward.

56. Haneys. Upper or Middle Coal capped by Loess in bluffs one mile east.

57. Steamboat Rock. At and about this place the Iowa River flows in a gorge 50 to 150 feet deep, which it has eroded in friable ferruginous sandstone and firm limestones. To reach the plateau in which the gorge is excavated the nascent river left a low-lying valley in its direct course, going some miles out of its way. This is one of the finest examples of the anomalous behavior of several Iowa rivers in avoiding valleys and seeking ridges and plateaus for their courses. (cf. Burl. Phil. Soc. Wash., VI, 1884, 93; Science II., 1883, 762; Trans. Iowa Hort. Soc. XLIII., 1883, 322.)

Ms. Dubuque and Dakota Railroad. Alt.			St. Louis, Keokuk and North-West. R. R.		
0 Hampton.	Drift ov. 13 S.-C. strata		0 Keokuk.	{ Loess, Drift, 13d. St. Louis, 13 c. Keokuk.	
12 Dumont.	" " ?		15 Boston. ⁶⁴	20 a. Drift.	
16 Bristow.	" 10 Hamilton.		17 Charleston.	"	
22 Allison.	" " "		32 Houghton.	"	
29 Clarksville.	10 b. Hamilton.	⁹¹⁴	87 Salem.	[Keok.	
36 Shell Rock.	" "		43 Oakland Mills.	Loess, " 13d. St. L., 13a.	
41 Waverly.	" "	⁹⁴³	49 Mt. Pleasant. ⁶⁴	" " " "	
64 Sumner.	Drift over 10 Hamilton				
Minneapolis and St. Louis Railway.			Wisconsin, Iowa and Nebraska Railroad.		
121 Norman.	20 a. Glacial Drift.		0 Des Moines. ⁷⁹⁹	Drift, Loess, 14a. L. C.	
127 Lake Mills.	" "		9 Berwick.	" 14 a. Low. Coal.	
142 Forest City.	" "		26 Mingo.	" "	
156 Britt.	" "		45 Melbourne.	" "	
167 Corwith.	" "		51 Luray. ⁶⁵	"	
176 Luverne.	" "		58 Marshalltown. ⁶⁶	{ 13 c. Keokuk. ⁶⁶⁶	
182 Livermore.	" "			{ 13 d. St. Louis ?	
192 Humbolt.	Drift, 13 a. Kinderh'k.		63 Rockton.	Drift.	
210 Ft. Dodge. ^{80 1015}	{ Drift, 18 Ft. Dodge,		74 Gladbrook.	{ Loess to S.-W., Drift,	
	{ 14a. L. C., 13d. St. L.			{ 14a. L. C., 13a. Kind.	
216 Kalo Junction.	20 a. Drift.		80 Berlin.	Drift.	
230 Dayton.	" 14 a. Low. Cl.		87 Reinbeck.	" over 10 Ham.	
246 Ogden.	" "		95 Hudson.	" "	
259 Angus.			105 Waterloo.	" "	
St. Louis, Des Moines and Northern R. R.			110 Cedar Falls.	Drift ov. 10 Hamilton.	
0 Des Moines. ²³	14 a. Lower Coal. ⁶⁰⁰		Fort Madison and North-Western R. R.		
21 Kelsey.	Drift over 14 a. L. Cl.		0 Fort Madison.	{ Drift, 13 c. Keokuk,	
43 Boone.	14 a. Low. Coal. ¹¹⁵⁵		8 Bluff Siding.	{ 13 b. Burlington. ?	
Des Moines, Osceola and Southern R. R.			6 Benbon.	Drift.	
0 Des Moines. ²³	14 a. Lower Coal. ⁶⁰⁰		32 McVeigh.	" 14 a. Low. Coal.	
11 Norwalk.	{ Drift & Loess ov. 14a.		41 Birmingham.	" "	
	{ L. C. & 14b. Mid. C. ?		Burlington and North-Western and Burlington and Western Railroads.		
18 Poole.	Drift, Loess over 14 a.		0 Burlington. ⁵⁰	As before. ⁵²⁶	
20 R. I. Crossing.	Drift, Loess.		20 Roscoe.	20 a. Drift.	
29 St. Charles.	" "		84 Winfield.	"	
50 Jamison. ⁶²	" "		39 Wyman.	" 20 b. Loess.	
58 Osceola.	Dft., Loess ov. 14a. U.C.		42 Crawfords.	20 a. Drift.	
72 Van Wert. ⁶³	Drift over "		47 Havre.	Drift, 13 d. St. Louis ?	
81 Decatur.	" "		52 Washington.	" 13 d. St. Louis.	
87 Leon. ⁶⁴	" "		40 Wayne.	"	
100 Harding.	" "		56 Brighton. ⁴²	{ Loess, 14 a., 13 d.	
111 Cainsville.	" "		66 Woolson.	" 14 a. Low. Coal.	
			84 Hedrick.	" "	
			95 Cedar.	" "	
			104 Oskaloosa.	" ⁶⁶⁰	

58. *Belmond Branch* traverses the eastern side of the Iowa loop of the Great Terminal Moraine of the Upper Mississippi Valley.

59. *Zearing*. The Terminal Moraine crosses the railway from north to south in this vicinity.

60. *Elgin*. Galena, Maquoketa and Niagara in eminences.

61. *Riverside*. Hamilton, with Kinderhook on south side of river.

62. *Jamison*. Drift—concealed eastern margin of Upper Coal probably near here.

63. *Van Wert*. Drift along valley sides generally overlain by Loess. The phase of Drift known as "hard pan" (a dense, tenacious blue or gray clay, weathering white) occurs in vicinity of this and succeeding stations.

64. *Boston to Mt. Pleasant*. Subterranean includes eastern salients of Lower Coal, the St. Louis and Keokuk, and, possibly, the Burlington.

65. *Luray*. About eastern margin of Lower Coal.

66. *Marshalltown*. Keokuk and St. Louis? with Lower Coal on adjacent hills.

67. *West Keithsburg to Oskaloosa*. Formations only approximately located.

Minnesota.*

LIST OF THE GEOLOGICAL FORMATIONS FOUND IN MINNESOTA.¹

FORMATIONS PER GENERAL LIST.	MINNESOTA SUB-DIVISIONS.	FORMATIONS PER GENERAL LIST.	MINNESOTA SUB-DIVISIONS.
20. QUATERNARY.	20. Quater. or drift.	4 a. TRENTON.	4 b. Galena l. &
18 CRETACEOUS.	18 b. Benton.	"	4 a. Trenton l. s.
"	18 a. Dakota.	3 a. CALCIFEROUS.	3 b. St. Peter s. s.
10. HAMILTON.	10 a. Hamilton l. s.	"	3 a. L. Magnesian. [†]
9 c. CORNIFEROUS.	9 c. Corniferous.	2 b. POTSDAM.	3 c. St. Croix s. s.
5 c. NIAGARA.	5 c. Niagara l. s.	"	{ 2 b. Potsdam s. s. of Wisconsin.
4 c. HUDSON RIVER.	4 c. Maquoketa sh.	1. ARCHÆAN.	2 a. Potsdam of Min.
			1. Archæan.

Potsdam sandstone of the Wisconsin geologists; 3 c. of this scheme for Minnesota (the St. Croix sandstone), and the Potsdam sandstone of New York is regarded as the equivalent of 2 a. by Prof. Winchell. Under the New York Calciferous are included the St. Peter sandstone, the Lower Magnesian (Shakopee, Jordan and St. Lawrence), and the St. Croix sandstone. N. H. W.

The course of glacial strata, and of transportation of the drift in eastern Minnesota, is southwest from Lake Superior to the Mississippi River; but in the west part of the State it is to the south and southeast, from Lake Winnipeg to Big Stone Lake, and into Iowa, excepting the southwest corner of the State, where the course is deflected to the southwest.

A tract adjoining the Mississippi River, from Lake Pepin to the southeast corner of the State, lies in a driftless area, which has a large extent toward the east and south in Wisconsin. W. U.

The four most notable features of the glacial drift in Minnesota are the following:

a. Its great depth, averaging 100 feet, and sometimes exceeding 200 feet, upon the western two-thirds of the State, where it generally covers all the surface of the older bed rocks. W. U.

b. The terminal moraines of the last glacial epoch. These belts of hilly and knolly drift reach from St. Paul and Minneapolis, north and northwest, to the Leaf hills and Itasca Lake. A great loop of the same formation also extends from Lake Minnetonka, by Albert Lea, into Iowa, to Pilot Mound, Mineral Ridge, and the vicinity of Des Moines, where it curves like the letter U, thence passing northwest by Storm Lake and Spirit Lake in Iowa, and along the elevated *Coteau des Prairies* through southwestern Minnesota into Dakota. W. U.

c. Lake Agassiz, which occupied the basin of the Red River of the North and Lake Winnipeg during the recession of the ice sheet, that being a barrier to prevent the water on this area from flowing to Hudson Bay as now. The beach of Lake Agassiz is well exhibited on the Northern Pacific Railroad close east of Muskoda. W. U.

d. The channel or valley in which lakes Traverse and Big Stone and the Minnesota River lie, excavated 100 to 225 feet in depth and about a mile in width. It was eroded by the outflow from Lake Agassiz; and the river thus formed has been named the River Warren, in honor of Gen'l George K. Warren, who first described this channel and showed its origin from the glacial lake in the Red River Valley. W. U.

Chicago, Milwaukee & St. Paul R. R. Ms. (Southern Minnesota Division) Alt.			Chicago, Milwaukee & St. Paul R. R. Ms. (Southern Minnesota Division.)—Con. Alt.		
0 Milwaukee.	3 c. St. Croix.	534	86 Grand Meadow.	{ 18. Creta. (prob- bly)	Heavy Drift.
0 La Crescent.	3 a. L. Mag. Bluffs.	647	101 Brownsdale.		
1 Grand Crossing.	"		106 Ramsay.		
32 Rushford.	"	722	113 Oakland.		
37 Peterson.	"	756	122 Hayward.		
46 Whalan.	"	786	128 Albert Lea.		
51 Lanesboro. ¹	"	841	138 Alden.		
57 Isinours. ²	"	899	147 Wells.		
62 Fountain.	{ 3 b. St. Peter.	1302	162 Delavan.		
	{ 4 a. under village.		171 Winnebago City. ¹³		
70 Wykoff.	{ 4 a. Tren. Frequent sink-holes.	1310	174 Winnebago.	20. Heavy drift.	
77 Spring Valley. ⁴	{ 10 a. Ham. uncon. on 4 c. Hud. River.	1266	191 Fairmount.		
			216 Jackson.	"	

* Prepared expressly for this work by Prof. N. H. Winchell, of Minneapolis, the State Geologist of Minnesota; with elevations and notes on glacial drift by Mr. Warren Upham, Assistant Geologist.

[†] Sub-divided into 3 Shakopee l. s., 2 Jordan s. s., and 1 St. Lawrence l. s.

1. The three sub-divisions of the Lower Magnesian: 1, St. Lawrence limestone; 2, Jordan sandstone; and 3, Shakopee limestone are here seen.

2. In the immediate river bluffs are the Jordan and Shakopee. Further back are the St. Peter and Trenton.

Chicago, Milwaukee & St. Paul R. R.			Chicago and North-Western Railroad.		
Ms.	Southern Minnesota Division.—Con.	Alt.	Ms.	Continued.	Alt.
240	St. P & S.C. Junc.	Heavy Drift. ³	574	Elkton.	{ 20. H'vy drift of the Coteau des Prairies
264	Fulde.	"			{ 20. H'vy drift, probably underlain by gneiss and schists.
263	Iona.	" 1705	552	Marshall.	" 1174
282	Edgerton.	"	565	Minnesota.	" 1179
296	Pipestone. ¹³	Quartzite & Catlinite. Dakota Line. 1744	576	Canby.	" 1243
Chicago & North-Western Railroad.			593	Gary. ¹¹ (Dakota Line.)	" 1484
297	Winona.	{ 8 c. St. Croix & 3 a. L. Mag. in bluffs.	Minnesota Valley Railway Division.		
303	Minnesota City.	"	479	Sleepy Eye.	Archæan. 1027
308	Stockton.	{ 8 c. St. Croix, 3 a. L. Mag. 753	481	Redwood Jc.	Heavy drift of the Coteau des Prairies ¹⁰⁰⁸
316	Lewiston.	" 1211	493	Morgan.	Heavy drift. 1043
319	Utica.	" 1170	499	Paxton.	" 1082
325	St. Charles.	{ 4 a. Tren. in bluffs. 3 b. St. Peter. " 3 a. Low. Mag. 1139	505	Redwood Falls.	{ 1. Archæan and 18. Cret. 1026
329	Dover.	3 b. and 4 a. 1135	Chatfield R. R. Branch.		
334	Eyota. ⁶	4 a. Trenton. 1237	334	Eyota. ³	Heavy d'ft 4 a. Tren. 1237
347	Rochester.	(Same as St. Chas.) ⁹⁹¹	335	Chatfield Junc.	Drift over Tren. 1273
356	Byron.	4 b. Galena l. s. 1250	346	Chatfield.	{ 4 a. Trenton, 3 b. St. Peter. 967
362	Kasson.	" 1252	Plainview R. R. Branch.		
368	Dodge Centre.	18. Cret. probably 1288	334	Eyota. ⁶	As before. 1237
375	Claremont.	" 1280	335	Plainview Junc.	20. Drift. 1278
382	Havana.	" 1246	337	Doty.	" 1310
387	Owatonna.	{ 4 a. Trenton. Heavy drift. 1144	340	Viola Centre.	" 1129
396	Meriden.	18. Cretaceous. 1149	345	Elgin.	{ 4 a. Tren. 3 a. Shakopee. 1069
402	Waseca.	{ 18. Cretac. Heavy drift. 1153	350	Plainview.	Drift. 1167
418	Janesville.	" 1063	Rochester & Northern Minnesota R'y Branch.		
428	Mankato Junc.	" 906	347	Rochester.	See main line. 991
428	St. Paul & Sioux City Junction.	3 a. Low. Magnesian.	348	Zumbrota Junc.	4 a. Trenton. 999
428	Mankato ⁵	18. Cretace's clays. ⁷⁸¹	355	Douglass.	" 1091
437	St. Peter.	" 812	360	Oronoco.	3 a. Shakopee. 1041
446	Oshawa.	" 982	364	Pine Island.	3 a. and 4 a. Tren. ⁹⁹⁸
467	New Ulm.	{ 2 a. Potsdam (conglomerate and red quartzite.) Granite. 837	368	Lena.	Drift. 1073
479	Sleepy Eye.	1. Archæan. 1034	373	Zumbrota.	{ 3 a. Shak., 3 b. St. Pet., 4 a. Tren. ⁹⁷¹
490	Springfield.	18. Cretaceous. 1026	Chicago, St. Paul, Minneapolis & Omaha Railway.		
498	Sanborn.	Prob. " 1089	0	St. Paul.	{ 3 b. St Peter and 4 a. Trenton. 704
506	Lamberton.	" " 1144	6	Mendota Junc.	" 718
516	Walnut Grove.	" " 1223	11	Nicols.	" 706
526	Tracy. ¹¹ 1403	{ 20. H'vy drift of the Coteau des Prairies	19	Hamilton.	{ 20. Quaternary, drift bluffs. 714
539	Balaton.	" 1628	22	Bloomington.	" 738
545	Redwood.	" 1028	28	Shakopee.	3 a. Low. Magnesian, Shakopee l. 741
553	Tyler.	" 1750	34	Merriam.	" 738
561	Lake Benton.	" 1759			
567	Verdi.	" 1771			

3. Overlying 3 a. Lower Magnesian, i. e., its two upper members, the 2. Jordan sandstone and the 3. Shakopee limestone, seen in the bluffs. Artesian well 2,000 feet in sandstone.

4. The cascade at Minneopa Falls, 30 feet high, is caused by the Jordan sandstone. This railroad crosses the gorge one-quarter mile below the fall.

Chicago, St. Paul, Minneapolis & Omaha Railway.—Continued.			Minneapolis & St. Louis Railway. Continued.		
Ms.		Alt.	Ms.		Alt.
39	Jordan.	749	27	Merriam Jc.	753
43	St. Lawrence.	{ Jordan s. s. 3 a. Low. Magnesian St. Lawrence.	32	Jordan.	753
47	Belle Plaine.	{ 18. Cretaceous over 3 a. Low. Mag. 723	42	New Prague.	Morainic Drift. 973
51	Blakely.	" 723	50	Montgomery.	" 1063
58	E. Henderson.	" 734	58	Kilkenny.	" 1056
62	Le Sueur.	{ 3 a. L. Mag., Shak- opee limestone, Jord- dan sandstone. 753	65	Waterville.	Flat Drift. 1004
69	Ottawa.	" 790	76	Waseca.	" 1151
75	St. Peter.	" 747	88	Richland.	" 1178
77	Kasota.	" 800	94	Hartland.	" 1237
86	Mankato. ³	791 " 18 a. Creta.	108	Albert Lea.	{ 18. Cret. (prob. over Devonian) and H'vy Drift. 1221
89	South Bend.	" 808	Cannon Valley Division.		
91	Minneopa. ⁴	" 871	0	Waterville.	Flat Drift. 1004
99	Lake Crystal.	18. Cret. H'vy drift. 994	6	Morristown.	Rolling Drift. 1004
109	Madelia.	" 1021	9	Warsaw.	" 1007
116	Lincoln.	" 1042	17	Faribault.	4 a. Tren. 3 b. St. P. 971
122	St. James.	" 1073	27	Dundas.	4 a. Tren. in bluffs. 926
137	Mountain Lake.	" 1300	30	Northfield.	3 a. Shakopee. 910
143	Windom.	" 1353	32	Waterford.	" 902
154	Wilder.	" 1448	38	Cascade.	" 893
160	Heron Lake	" 1417	45	Cannon Falls.	{ 4 a. Tren., 3 b. St. Pet. 3 a. Shak. 814
170	Hersey.	" 1485	55	Belle Creek.	Low. Mag. in bluffs. 707
178	Worthington. ⁷	" 1582	66	Redwing.	{ 3 a. Low Mag., 3 c. St. Croix. 706
Blue Earth Branch.			Pacific Division.		
0	Lake Crystal.	18. Cret. h'vy dr'ft. 994	0	Minneapolis.	{ 4 a. Trenton, 3 b. Peter s. s. 825
5	Garden City.	3 a. Shakopee. 966	8	Hopkins.	Morainic Drift. 922
11	Vernon Center.	Drift. 1028	12	Minnetonka Mills	" 936
16	Amboy.	" 1048	19	Excelsior.	" 947
24	Winnebago City. 13	" 1101	25	Victoria.	" 936
34	Blue Earth City.	" 1088	31	Waconia.	" 986
44	Elmore.	" 1181	39	Young America.	" 993
Pipestone Branch.			40	Norwood.	" 976
0	Heron Lake.	18. Cret. h'vy dr'ft. 1425	48	Green Isle.	" 999
8	Dundee.	20. Drift. 1483	54	Arlington.	Flat Drift. 993
20	Avoca.	" 1542	62	Gaylord.	" 992
31	Hadley.	" 1699	69	Winthrop.	" 1016
44	Woodstock.	" 1832	77	Gibbon.	Flat dr'ft on Arch. 1046
65	Pipestone.	Quartzite & catlinite. 1729	86	Fairfax.	" 1041
68	Dakota Line.	" 1724	94	Franklin.	" 1005
Rock River Branch.			100	Morton.	" 841
0	Lu Verne.	Drift & Potsdam. 1468	107	Redwood.	Archæan. Undulating Drift.
8	Ash Creek.	" 1405	123	Echo.	"
16	Rock Rapids.	" 1464	130	Wood Lake.	"
28	Doon.	" 1294	135	Hanley.	"
Minneapolis & St. Louis Railway.			146	Clarkfield.	"
0	Minneapolis. ⁸	{ 4 a. Trent. 3 c. St. Peter s. s. 825	162	Dawson.	"
21	Chaska.	3 a. Calciferous. 725	171	Madison.	"
23	Carver.	" 719	189	Revillo.	"
26	Sioux City Jo.	" 753	206	Troy.	"
			223	Watertown.	"
			St. Paul & Duluth Railroad.		
			1	St. Paul.	{ 4 a. Trenton. 704
			3	Post's.	{ 3 b. St. Peter s. s. 4 a. Trenton. 847

St. Paul & Duluth Railroad.			Northern Pacific Railroad.—Continued.		
Ms.	Continued.	Alt.	Ms.	Little Falls & Dakota R. R.	Alt.
.....	W. D. Junction.	4 a. Trenton.	0	Little Falls.	{ Staurolitic & garnetiferous mica schists. 1115
12	W. Bear Lake.	3 b. St. Peter s. s.	8	La Fond.	Drift. 1184
.....	Stillwater Junc.	3 a. Calciferous. 984	16	Swanville.	" 1173
17	Centreville.	" 981	25	Gray Eagle.	" 1223
25	Forest Lake.	" 909	29	Birch Lake.	" 1236
30	Wyoming.	2. Primordial.(?) 896	31	Spaulding.	" 1292
42	North Branch.	" 894	38	Sauk Center.	Archæan. 1232
47	Harris.	" 893	48	Westport.	" 1232
54	Rush City.	" 916	53	Villard.	Drift on Archæan 1353
64	Pine City.	" 949	60	Glenwood.	" 1401
77	Hinckley.	" 1081	59	Starbuck.	Drift. 1159
87	Miller.	" 1136	79	Cyrus.	" 1126
95	Kettle River.	" 1020	88	Morris.	" 1124
110	Moose Lake.	Taconic. 1064	Chicago, Milwaukee & St. Paul Railway.		
115	Barnum.	" 1097	Southern Minnesota Division.		
121	Black Hoof.	" "	0	Wells.	Heavy Drift. 1158
132	N. P. Junction.	" 1081	9	Minn Lake.	" 1033
123	Thompson.	" 1032	19	Mapleton.	" 1031
141	Fond du Lac.	Potsdam. 603	25	Good Thunder.	" 974
155	Duluth.	Cupiferous. 603	37	St. P. & S. C. Jc. ^s	{ 3 a. Low. Mag. Shak. 795 1. s. 18 Cret. 795
Stillwater Branch.			33	Mankato. ^s	{ 18. Cret. L. M. Shak. 1. s. Jordan. s. s. 770
0	White Bear.	Drift. 935	Wabasha Division.		
13	Stillwater.	3 a. Calciferous. 697	0	Wabasha.	{ 3 a. L. Mag. 3 c. St. Croix in bluffs. 712
Minneapolis Branch.			13	Glasgow.	" 716
0	Minneapolis. ^s	Trent. and St. Peter's. 985	20	Theilman.	" 743
15	White Bear.	Drift. 985	29	Millville.	" 737
Taylor's Falls Branch.			34	Hammond.	3 a. L. Mag. in bl'fs. 792
0	Wyoming.	2. Primordial.(?) 896	42	Zumbro Falls.	" 837
21	Taylor's Falls.	St. Croix. s. s. 741	52	Mazeppa.	" 925
	Passenger Dep't.		53	Forest Mills.	" 970
Knife Falls R. R. Branch.			60	Zumbrota.	" Shak. 1. s. 980
0	N. P. Junction.	Huronian Slates. 1082	Hastings & Dakota Division.		
6	Cloquet.	" 1176	0	Minneapolis. ^s	4 a. Tren., 3 c. St. Pet.
Northern Pacific Railroad.			9	Hopkins.	Heavy Drift. 912
Fergus Falls and Black Hills R. R.			18	Chanhasen.	" 966
0	Wadena. ¹²	Heavy drift with many glacial lakes and moraine hills. 20.	22	Hazeltine.	" 924
1	Wadena Junc.		27	Augusta.	" 974
10	Deer Creek.		31	Benton Jc.	Heavy drift. 943
14	Parkton.		33	Cologne.	" 943
18	Henning.		0	Hastings.	{ 3 a. Low. Mag. & St. Croix bluffs. 707
24	Vining.		8	Vermillion.	" "
29	Clitheral.		12	Auburn.	3 a. Low. Mag. 861
33	Battle Lake.		18	Farmington.	3 b. St. Peter s. s. 904
39	Maplewood.		22	Fairfield.	" or 4 a. Tren. 943
41	Southwick.				
42	Underwood.				
53	Fergus Falls. ¹²				
60	Ames.				
68	Everdell.				
77	Breckenridge.				
Dakota Line.					

5. *Castle Rock.* The outlier of the St. Peter sandstone, 70 feet high, visible from the station toward the east gives the name to the place.

Chicago, Milwaukee & St. Paul R. R.—Con. (Hastings & Dakota Div.)—Con.			Alt.	Chicago, Milwaukee & St. Paul R. R.—Con. (La Crosse & St. Paul Division.)—			Alt.
33	Prior Lake	{ 3 a. St. Peter s. s. or 4 a. Trenton.	949	306	Winona.	{ 3 a. Low. Mag. & 3 c. St. Croix s. s. com- pose the bluffs.	662
41	Shakopee.	3 a. Shakopee l. s.	756	313	Minnesota City.	"	677
45	Chaska.	3 a. Cal. heavy drift	728	323	Minneiska.	"	673
48	Carver.	"	815	326	Weaver.	"	674
54	Glencoe.	{ 20. Heavy drift, un- derlain by l. Arch- ean rocks.		333	Kellogg.	"	702
89	Bird Island.	{ Alternating beds of gneiss and schists.		340	Wabasha.	"	713
114	Granite Falls. ⁹	{ Red and gray gneiss.		342	Reed's Landing.	"	683
137	Montevideo.	20. Drift.		352	Lake City.	"	703
167	Appleton.	{ Heavy exposures of gneiss & granitoid gneiss, with con- spicuous glaciation parallel with the Minnesota River Valley.		359	Frontenac.	"	720
		(Dakota Line.)		369	Red Wing.	"	687
				390	Hastings.	"	709
173	Odessa.			396	Langdon.	"	818
178	Junc. Switch.			401	Newport.	"	731
182	Ortonville.			409	St. Paul.	{ 4 a. Trenton. 3 b. St. Peter.	704
				.....	Fort Snelling.	"	
				.....	Minnehaha.	"	
				424	Minneapolis. ⁸	"	
(Iowa & Minnesota Division.)				Minneapolis & St. Louis Railway.			
0	N. McGregor.	(See Iowa.)	633	0	Minneapolis. ⁸	{ 4 a. Trenton. 3 c. St. Peter s. s.	825
85	Le Roy.	10. Hamilton.	1280	21	Chaska.	3 a. Calciferous.	725
96	Adams.	"	1276	23	Carver.	"	719
111	Austin.	{ 18 a. Cretaceous on Marcellus.	1197	26	Sioux City Junc.	"	753
114	Ramsey.	"	1215				
117	Lansing.	Heavy drift.	1224				
126	Blooming Prairie	"	1286				
135	Aurora.	"	1253				
144	Owatonna.	{ 4 a. Tren. on river banks.	1144				
150	Medford.	3 a. River Terr's.	1098	0	St. Paul.	{ 4 a. Trenton. 3 c. St. Peter s. s.	704
159	Faribault.	{ 4 a. Trenton. 3 a. St. Peter.	1002	10	E. Minneapolis.	"	842
170	Dundas.	3 a. L. Mag. (Shak.)	955	11	Minneapolis.	"	834
173	Northfield.	{ 3 a. Cal. & 4 a. Tren. on high bluffs.	915	25	Wayzata.	18. Cretaceous. ⁷	986
179	Castle Rock. ⁵	{ 3 b. St. Peter s. s. & 4 a. Tren. near	935	28	Long Lake.	"	984
186	Farmington.	4 a. Trenton. Heavy	904	33	Maple Plain.	"	1023
193	Rosemount.	" drift.	959	35	Armstrong.	"	
199	Westcott.	"	882	43	Delano.	2. Primordial. ⁷	928
206	St. Paul Junc.	"	759	49	Waverly.	"	999
212	St. Paul.	704 " & 3 b. St. Pet.		54	Howard Lake.	"	1010
				57	Smith Lake.	"	1054
				61	Cokato.	{ 1. Metamorphic probably	1060

6. *Spring Valley.* At four miles east is the best exposure of *Rhyacconella*, *Orthis* and *Strophomena* I have seen. At Spring Grove, on the Preston Branch of the Chicago, Milwaukee & St. Paul, have been found the largest *Trilobites* known of their kind (*Isotoles*). Similar ones have been seen three or four miles northwest of Eyota, on Chicago & Northwestern Railroad. Two miles north Kasson building stone of Galena formation (Upper Magnesian) are quarried of any size, 2½ inches thick. At Stockton and Lewiston, the lower Magnesian of similar dimensions are quarried by the Railroad Co. Same beds are wrought at Mankato somewhat thinner—supply unlimited. Orthoceratida, 10 inches in diameter, 8 or 10 inches long, have been found in lower Trenton about Rochester. W. D. HURLBUR.

Some persons prefer to call this the Upper Magnesian limestone. In going from Spring Valley east, we ascend over 183 feet of layers of this rock in four miles on the railroad.

7. *Worthington.* The drift here is supposed to be 700 ft. elevation above tide; near town is over 1,800 ft.

8. The Falls of St. Anthony, at Minneapolis, are caused by the rapid wearing out of the very friable St. Peter sandstone under the Trenton limestone, leaving a projecting shelf of the latter.

9. *Granite Falls* is a reef or bar of quartzite (probably metamorphic). It is expected that the most of our quartzites will prove to have been Potsdam. They appear in proper horizon as do those at Devils Lake, Wis., and Sioux Falls, Dakota. Boulders from these quartzite rocks are widely distributed in Minnesota.

W. D. H.

St. Paul, Minneapolis & Manitoba Ry.—				St. Paul, Minneapolis & Manitoba Ry.—			
Ma.	Continued.	Alt.		Ma.	Continued.	Alt.	
67 Dassel.	1. Metamorph.	1089	Heavy Drift.	11 Parker.	Probably Cambrian and 1. Archean covered with drift and water deposits.		
72 Darwin.	" Probably	1132		22 Osseo.			
78 Litchfield.	"	1139		84 Hassan.			
86 Swede Grove.	"	1192		39 Crow River.			
91 Atwater.	"	1211		44 St. Michaels.			
98 Kandiyohi.	"	1222		48 Monticello.			
104 Willmar.	"	1129		56 Silver Creek.			
111 St. John's.	"	1121		63 Clearwater.			
118 Kerkhoven.	"	1108		69 Augusta.			
127 De Graff.	"	1061		75 St. Cloud.			
134 Benson.	"	1047		82 St. Joseph.			
140 Clontarf.	"	1044		85 Collegeville.			
150 Hancock.	"	1155		90 Avon.			
159 Morris.	"	1139		96 Albany.			
168 Donnelly.	"	1124		108 Freeport.			
178 Herman.	1. Archæan.	1070		109 Melrose.			
185 Gorton.	"	1022		117 Sauk Centre.			
194 Tintah.	"	995		125 West Union.			
201 Campbell.	"	982		130 Osakis.			
209 Doran.	"	971		142 Alexandria.			
217 Breckenridge.	" Perhaps Cretac's.	959		148 Garfield.			
(Branch Line St. Paul, Min. & Man. Railway.)				154 Brandon	20. Heavy drift. 1. Archean, with exposures of granite and syenite (at and near St. Cloud), and high moraine near St. Cloud), and hills and num- gneiss and diorite (Sank Centre.)		
0 St. Paul.	Heavy drift.	{ 4 a. Trenton. 704	166 Interlaken.				
10 St. Anthony.		{ 3 a. St. Peter s. s. 842	176 Dalton.				
17 Manomin.		{ 4 a. Trenton. 842	186 Fergus Falls.				
27 Anoka.		{ 3 b. St. Peter s. s. 848	196 Carlisle.				
34 Itasca.		{ 3 a. Calciferous. 878	204 Rothsay.				
39 Elk River.		{ " 891	212 Lawndale.				
48 Big Lake.		{ 2. Primordial. 896	218 Barnesville.				
56 Becker.		{ " 940	232 Sabin.				
63 Clear Lake.		{ " 977	241 Moorhead.				
75 St. Cloud.		{ 1. Archæan. 997					
76 Sauk Rapids.		{ " 1012	St. Paul, Stillwater & Taylor's Falls R. R.				
108 Melrose.		{ " 1004	0 St. Paul.	{ 4 a. Trenton, 704			
		{ " 1198		{ 3 a. St. Peter s. s.			
0 St. Paul.		{ 2-4. Low. Silur. and	3 Post's.	{ 4 a. Trenton. 847			
..... Minneapolis.		{ Cam. l. s. and s. s.	12 St. Elmo.	{ " 988			
			16 Stillwater Junc.	{ 3 a. Calciferous. 887			
			20 Stillwater.	{ " 697			

* The main line of the Northern Pacific Railroad is given in a separate chapter.

10. The standard thickness of the formations in Minnesota of the palæozoic rock is: downward, Galena, or Upper Magnesian, 183 feet; Upper Trenton, gray limestone, 120 feet; a green shale, 15 feet; Lower (blue) Trenton, 17 feet; St. Peter sandstone, 115 feet; Lower Magnesian, 250 feet; Potsdam, perhaps, 1,000 feet. The upper measures are greatly corroded and show but a small part of the several measures, except the Lower Trenton and its invariable associate the St. Peter sandstone, giving such uniformity of escarpment as will be found in no other formations. The Upper Trenton is usually corroded well back from the front of any bluff and shows light slopes. W. D. H.

11. From Tracy to Gary, on the southwest, are to be seen the foothills of the *Coteau des Prairies*. Going west from Tracy the railroad passes into a valley between two morainic hills, and near Canby the ascent of the *Coteau* is begun, the summit of which is reached at Goodwin, Dak., at 1,996 feet above the sea. C. W. H.

12. From Wadena to Fergus Falls the railway passes through the beautiful "Lake Park Region," with the abrupt morainic mounds of the Leaf Hills and numerous glacial lakes. Near Ames and Everdill are the beaches of the glacial lake Agassiz (Upham.) C. W. H.

13. Winnebago City is on the deposits of a glacial lake (Upham.) After crossing the Des Moines River the *Coteau des Prairies* is ascended. The three highest points between the Des Moines and the James Rivers are: Four miles west of Iona, 1,705 feet; four miles east of Pipestone City, 1,744 feet; west of Lake Herman, Dak., 1,825 feet. At Pipestone City occur the beds of quartzite and Catlinite (Indian Pipestone), of either Cambrian (Winchell), or Huronian (Chamberlin and Irving). C. W. H.

St. Paul, Minneapolis & Manitoba Railway.			St. Paul, Minneapolis & Manitoba Railway.—Continued.		
Alt.		Ms.	Ms.		Alt.
.....	Breckenridge.	(See No. Pacific.) 959	Brown's Valley Line.		
.....	Manston.	20. Drift. 976	0 Morris.	Drift covered.	1129
.....	Atherton.	20. Drift. 979	13 Chokio.	"	1132
218	Barnesville.	Drift. 1007	26 Graceville.	"	1107
225	Downer.	" 968	St. Cloud & Hinckley Branch.		
235	Glyndon.	{ Flat drift in the bed of the ancient lake Agassiz. 932	0 Hinckley.	2 a. Potsdam s. s.	1021
241	Averill.	" 927	7 Pokegama.	Drift.	1015
249	Felton.	" 925	22 Mora.	"	986
254	Borup.	" 921	26 Ground House.	"	1027
264	Ada.	" 907	39 Millaca.	"	1054
275	Rolette.	" 895	41 Bridgman.	"	1080
280	Beltrami.	" 905	47 Oak Park.	"	1115
285	Russia.	" 895	50 St. Francis.	"	1097
290	Kittson.	" 888	53 Foley.	"	1123
297	Carman.	" 885	67 St. Cloud.	See Main Line.	1023
298	Crookston.	" 868	Pelican Rapids Line.		
304	Shirley.	" 905	0 Pelican Rapids.	Drift.	1319
311	Euclid.	" 895	6 Ehrhardt.	"	1301
319	Angus.	" 875	14 Elizabeth.	"	1256
327	Warren.	" 858	21 N. P. Junction.	"	1174
337	Argyle.	" 850	23 Fergus Falls.	See Main Line.	1183
346	Stephen.	" 832	Duluth & Iron Range Railroad.		
357	Donaldson.	" 831	0 Duluth.		
361	Kennedy.	" 830	26 Two Harbors.	Trap rock.	634
370	Hallock.	" 820	32 Sibbissa.	20. Drift.	1230
375	Northcote.	" 807	38 Gakadina.	"	1784
382	Humbolt.	" 797	49 Wissakode.	"	1578
389	St. Vincent.	" 792	62 St. Louis River.	River drift.	1607
391	Boundary Line.	" 795	70 Okwanim. ¹⁵	Gabbro range.	1494
Sauk Centre & Northern Branch.			75 Mesaba Heights.	Granite.	1604
0	Sauk Centre.	Sauk Centre. 1232	80 Embarrass R.	20. Drift.	1440
10	Little Sauk.	{ Covered with drift. 1371	93 Tower.	Slates & schists, with jasp. & hematite.	1424
19	Long Prairie.				
26	Browerville.				
32	Clarissa.				
37	Eagle Bend.	1371			

Notes signed C. W. H. are by Prof. C. W. Hall.

14. *Taylor's Falls*. The primordial is here very fossiliferous and lies unconformably on trap rock, supposed to be *Cuprifera*.

15. The great Mesabi range of Gabbro is crossed between St. Louis river and Okwanim. The *Mesaba Heights*, as here named, is on a range of granitic rocks, the apparent equivalent of the Giant's range known further northeast in Canada.

Errata: Page 246, after Wisconsin geologists, read, is equivalent to 3 c., etc.

Note 6. For "of *Rhyacconella*," read, for *Rhynchonella*.

Note 7. For "700," read 1,700.

Note 9. For "is a reef or bar of quartzite," read, are caused by a grey gneiss.

North and South Dakota.¹

Chicago, Milwaukee & St. Paul Railroad.			Chicago, Milwaukee & St. Paul.—Con.		
Iowa and Dakota Division.			Sioux City and Dakota Div.—Con.		
Ms.		Alt.	Ms.		Alt.
332 Mitchell. ²	{ 18 a. & b. Cretaceous. 2d Moraine. 1294		62 Fairview.	{ 18 b. Cretaceous, Drift & Loess. 1207	
347 Letcher.	{ 18 b. Cretaceous, Deep Till. 1300		68 Beloit.	" " 1238	
361 Woonsocket.	" " 1308		71 Canton.	18 b. Cret. Till. 1241	
388 Woolsey.	" " 1353		91 Sioux Falls. 1386	1 b. R. Quartz. 1st Mor.	
420 Redfield.	18 b. Cretaceous. 1295		21 Elk Point.	Alluvium. 1124	
429 Ashton.	1296 "Lacust'l Alluv.		29 Burbank.	" " 1135	
461 Aberdeen.	1301 " " & Till.		35 Vermillion.	{ 18 b. Cretaceous, Drift and Loess. 1143	
355 Plankinton.	Deep Till. 1521		44 Meckling.	" " 1149	
367 Yorkton.	" " 1639		50 Gayville.	Alluvium. 1169	
379 Kimball. 1781	1st or Principal Mora.		61 Yankton.	{ 18 b. Cretaceous, Drift and Loess. 1186	
390 Puckwana.	{ Lacustral Alluvium, and Till. 1539		70 Utica.	Drift. 1329	
399 Chamberlain. ³	{ 18 b. Cret (Berg) 1356 Till on Uplands.		78 Lesterville.	1st Moraine. 1375	
(Canton to Mitchell.)			90 Scotland.	18 b. Cret., Till. 1340	
252 Canton.	18 b. Cret., Till. 1241		South Minnesota Division.		
262 Worthing.	" " 1357		0 Woonsocket.	18 b. Cret., Till. 1308	
268 Lennox.	" " 1347		9 Forestburg.	" " 1280	
381 Parker. ⁴	{ 1 b. Red Quartzite, and 2d Mor. 1341		19 Diana.	" " 1311	
287 Marion Ju.	" " 1440		30 Roswell.	" " 1398	
287 Marion Ju.	" " 1440		38 Howard.	" " 1561	
298 Freeman.	Till and 2d Mor. 1504		Winfred.	" 2d Mor. 1704	
309 Menno.	Till. 1317		Russell.	" 1st " "	
319 Scotland.	18 b. Creta., Till. 1340		60 Madison.	Drift. 1659	
343 Springfield.	" " 1227		75 Coleman.	Drift Plain. 1687	
350 Running Water.	" " 1213		0 Sioux Falls.	1 b. R. Quartz., Dft. 1386	
287 Marion Ju.	" " 1440		20 Dell Rapids.	" " 1485	
303 Bridgewater.	{ 1 b. Red Quartzite, Till. 1413		85 Egan.	Drift. 1522	
318 Alexandria.	" " 1345		89 Flandreau.	" " 1562	
332 Mitchell.	{ 1 b. Red Quartzite, 18 a. and b. Cretaceous, 2d Mor. 1294		Airlie.	" " 1641	
Sioux City and Dakota Division.			104 Pipestone.	" " 1705	
0 Sioux City.	{ 18 a. Cretaceous, Drift and Loess. 1097		Hastings and Dakota Division.		
8 McCook.	Alluvium. 1105		0 Ipswich.	18 b. Cret., Till. 1531	
13 Jefferson.	" " 1111		18 Mina.	" 3d Mor. 1433	
21 Elk Point.	" " 1124		26 Aberdeen.	" Lac'l Silt. 1801	
21 Elk Point.	" " 1124		34 Bath.	" " 1301	
38 Westfield.	" " 1124		45 Groton.	" " 1304	
33 Akron.	{ 18 a. and b. Cretac., Drift and Loess. 1148		55 Andover.	" 3d Mor. 1476	
47 Calliope.	18 b. " " 1175		65 Bristol.	" 2d " 1775	
55 Eden.	" " 1215		77 Webster.	Till. 1842	
65 Rock Valley.	" " 1246		87 Waubay.	Till and 1st Mor. 1813	
58 Austin.	" " 1197		Wilmot.	" 3d " 1196	
			123 Millbank.	" " 1148	
			134 Big Stone City.	1 a. Gran., Till & All. 979	
			135 Ortonville.	" " " 997	
			James River Line.		
			9 Aberdeen.	Till & Lacust'l Silt. 1301	
			12 Westport.	18 b. Cretac., Till. 1233	
			37 Ellendale.	" " 1456	
			64 Edgeley	" " 3d Mor. 1516	

Chicago, Milwaukee & St. Paul R. R.—Con.			Chicago & North Western R'y.—Con.		
Ms.	Fargo Southern Line.	Alt.	Ms.	(Elkton to Redfield.)	Alt.
0	Ortonville, Minn.	Till. Archæan 997	574	Elkton.	Drift Plain. 1751
22	Graceville, "	granites extensive- ly exposed in val- ley of Minnesota River. 1109	584	Aurora.	" 1630
49	White Rock.	Lacustrine de- 971	590	Brookings.	" 1636
66	Tyler.	posits of Lake Agassiz overly- 967	597	Volga.	" 1636
88	Abercrombie.	ing till. " 933	608	Nordland.	1st Moraine. 1846
120	Fargo.	" 903	619	Preston.	Till. 1696
Hastings and Dakota Line.—Con.			644	De Smet.	2d Moraine. 1726
0	Ipswick.	Till. 1531	653	Iroquois.	Till. 1401
16	Roscoe.	" 1827	653	Cavour.	2d Moraine. 1311
81	Bowdle.	1st & 2d Moraine. 1996	662	Huron.	Till. 1293
Roscoe and Orient Branch. 6.			675	Woolsey.	3d Moraine. 1363
0	Eureka.	Till & 2d Moraine. 1885	687	Wessington.	" 1419
8	Hillsview.	" 1850	699	St. Lawrence.	Till. 1580
26	Roscoe.	" 1827	713	Ree Heights.	{ 18 b. Cretaceous, 1st & 2d Mora. 1791
49	Millard.	" 1641	725	Highmore.	2d Moraine. 1890
58	Faulkton.	" 2d Moraine. 1574	739	Harold.	Till. 1401
68	Orient.	" 1600	752	Blunt.	{ 18 b. Cretaceous, 1st Moraine. 1611
Chicago and North Western R'y. Eagle Grove and Hawarden Line.			761	Canning.	" 1553
514	Hawarden.	1181	781	Pierre. (Missouri River.)	" 1440
522	Alcester.	Till and Loess. 1346	662	Huron.	Till. 1285
531	Beresford.	1st Moraine. 1505	675	Broadland.	" 1308
541	Centerville.	18 b. Cret., Till. 1229	684	Hitchcock.	3d Moraine. 1359
554	Hurley.	" " 1268	703	Redfield.	18 b. Cret., " 1300
563	Parker.	1b. Red Quartzite. 1340	(Watertown Junction to Watertown.)		
579	Canistota.	18 b. Cret. 2d Mor. 1455	0	Watertown Ju.	1604
590	Salem.	" Till. 1617	8	Bruce.	Drift. 1640
602	Canova.	" " 1527	18	Estelline.	" 1659
612	Vilas.	" " 1480	30	Castlewood.	" 1685
624	Carthage.	" " 1438	44	Watertown.	" 1785
631	Esmond.	" " 1433	St. Paul, Minneapolis & Manitoba R. R.		
640	Iroquois.	" " 1401	241	Morehead, Minn.	{ Plain of Lake Agas- siz. Lacus'l Dep. 903
658	Huron.	3d Moraine. 1311 Till. 1285	242	Fargo, Dak.	" 861
Minnesota and Central Dakota Line.			251	Harwood.	" 866
593	Gary.	2d Moraine. 1484		Argusville.	" 884
	Altamont.	1st " 1834	263	Gardner.	" 886
	Goodwin.	Old Till. 1996	269	Grandin.	" 891
	Kransburg.	" 1932	275	Kelso.	" 897
631	Watertown.	1st Moraine. 1735	281	Hillsboro.	" 901
649	Henry.	Till. 1812	289	Cummings.	" 928
662	Clark Centre.	2d Moraine. 1789	295	Buxton.	" 930
	Raymond.	Till. 1458	300	Reynolds.	" 910
681	Doland.	3d Moraine. 1353	307	Thompson.	" 893
691	Frankfort.	Alluvium & Till. 1296	320	Grand Forks.	" 830
702	Redfield.	18 b. Cret., 3d Mor. 1300	333	Manvoel.	" 819
713	Athol.	" Lac'l Allu. 1296	345	Ardock.	" 824
723	Northville.	" " 1299	351	Minto.	" 827
736	Rudolph.	" & Till. 1301	360	Grafton.	" 840
744	Aberdeen.	" " 1300	374	St. Thomas.	" 824
753	Ordway.	" " 1314	387	Hamilton.	" 821
759	Columbia.	" " 1315	392	Bathgate.	" 821
			400	Neche.	" 821
			402	Gretna, Canada Line.	"

L. By Profs. T. C. Chamberlin and J. E. Todd, U. S. Geologists, with elevations by Mr. Warren Upham, Assistant on the Geological Survey of Minnesota and the U. S. Survey. The geology of the two States is given in one chapter without reference to the division recently made.

St. Paul, Minneapolis and Manitoba Railroad.—Con.				St. Paul, Minn. & Manitoba R. R.—Con.			
Ms.	Breckenridge	Extension.	Alt.	Ms.	Aberdeen Branch.—Con.	Alt.	
0	Breckenridge.	{ Lacustrine	959	64	Havana.	{ Till, Lacustrine ¹²⁹⁴	
18	Dwight.	{ Champlain.	952	71	Kidder.	{ plain Lake Dakota.	
21	Colfax.	"	953	78	Burch.	" "	1295
53	Everest.	"	953	84	Amherst.	" "	1296
80	Greenfield.	Drift.	945	91	Clarmont.	Till. 4th Mor.(?)	1312
99	Mayville.	"	975	96	Huffman.	" Lake Dakota.	1302
131	Larimore.	"	1134	102	Putney.	" "	1307
145	Orr.	"	1098	110	Hadley.	" "	1308
155	Conway.	"	988	119	Aberdeen.	" "	1302
167	Park River.	"	998			" "	1300
Devils Lake Extension.				Northern Pacific Railroad. ⁵			
0	Crookston. ⁸⁶³	Lacustrine Champlain		Ms. Jamestown and Northern Railroad.	Alt.		
28	Grand Forks.	"	830	0	Jamestown. ¹⁴⁰⁶	18.Cret., Till & V y Drift.	
57	Larimore.	Drift & 18. Creta.	1134	6	Parkhurst.	" "	1500
83	Michigan City.	"	1517	13	Buchanan.	" "	1546
118	Devils Lake, Sta.	"	1464	21	Pingree.	" "	1548
	Devils Lake, Wa. ter.	"	1432	34	Melville.	" "	1601
Hope Branch.				43	Carrington.	" "	1582
0	Ripon. ¹⁰⁴²	Drift, Beach—near.		60	New Rockford.	" "	1528
4	Ayr. ¹²⁰²	" 18 Cretaceous. ?		56	Sykeston.	" "	1680
16	Page City.	" " ?	1177	Fargo and Southwestern. ⁶ —Con. 11			
23	Colgate.	" " ?	1179	88	La Moure.	{ 18 b. Cretaceous	
29	Hope.	" " ?	1243		Glover.	{ Till.	1305
Aberdeen Branch. ⁶					Oakes.	{ " Beach of	1310
0	Tintah Jc.	{ Lake Agassiz	938		Berlin.	{ Lake Dakota.	
25	Hankinson.	{ deposits.			Medbury.	18 b.Cret. Till.	1463
37	Lidgerwood. ⁹	Herman Beach.	1068		Edgeley.	" "	1520
55	Rutland.	Till.	1122			" 3d Mor.	1516
58	Sprague Lake. ¹⁰	"	1225	Chicago, St. Paul, Minneap. & Omaha R. R.			
		"	1219	(Sioux Falls Branch.)			
				0	Sioux Falls.	{ 1. Red Quartzite,	
					Hartford.	{ Drift Alluvium. ¹³⁹⁴	
				14	Montrose.	Drift.	1561
				28	Salem.	1 & 2d Moraines.	1471
						Till.	1517

2. *Mitchell*. Dakota s. s. (18 a.) finely exposed along Enemy Creek five miles east of south. Also on the Firesteel at and near the crossing of the Letcher Branch. *Niobrara* (?) (Chalkstone) 18 b. along the railroad one mile east, and along the Firesteel a mile northeast and further up. This with the clays of probably the Ft. Benton frequently struck in deep wells.

3. *Chamberlain*. *Niobrara* and Fort Pierre clays (18 b.) exposed over 350 feet in the sides of the bluffs, 40 to 50 feet of Till, probably of glacio-natant origin, cap the bluffs and several feet of Loess frequently covers that.

4. *Parker*. Red Quartzite of Dakota which is 1 b. Huronian, is exposed along the Vermillion near the level of the water two miles east.

5. The main line of the Northern Pacific is given in a separate chapter.

6. Elevations, as well as geology, on this line by Prof. J. E. Todd.

7. *Bowdle*. Unusually fine exhibition of gravel plains and ridges, in a broad re-entrant angle of the first and second moraines which are here united. They are crossed two to three miles east of the town.

8. *Faulkton*. The hills southwest are the eastern head of a re-entrant angle or interlobular portion of the second moraine.

9. *Lidgerwood*. An interlobular portion of the fourth and fifth moraines is well developed a few miles south. The latter is crossed near Genesee.

10. *Sprague Lake*. Near the head of Coteau des Prairies, third and fourth moraines at its base, the second at its summit.

11. The Fargo and Southwestern is continued from the Northern Pacific chapter.

St. Paul, Minneapolis and Manitoba.			St. Paul, Minneapolis and Manitoba.		
Ms.	Continued.	Alt.	Ms.	Cando and St. John Line.—Con.	Alt.
352	Shawnee.	{ Drift and 18 c.	459	Perth.	D'ft. 18c. Ft. Pierre. 1731
405	Devil's Lake.	" Ft. Pierre.	471	Rolla.	" " 1818
413	Grand Harbor. ¹³	" " 1464	479	St. John. ¹⁶	" " 1945
424	Church's Ferry.	" " 1454	Bottineau Branch.		
436	Leeds.	" " 1514	463	Rugby Junc.	D'ft. 18c. Ft. Pierre. 1561
442	York.	" " 1612		Barton.	" " 1505
448	Knox.	" " 1605	484	Willow City.	" " 1471
453	Pleasant Lake.	" " 1603	504	Bottineau. ¹⁶	" " 1638
463	Rugby Junc.	" " 1561	Aberdeen, Bismark and N. Western Ry. 6		
474	Berwick.	" " 1482	Aberdeen.	1295	Till. Lacustral Silt.
481	Towner.	" " 1475	Foster.	1381	18 b. Cretaceous, Till.
487	Denbigh.	" " 1485	Leola.	"	" 1587
500	Granville.	" " 1503	Ashley. ¹⁷	2001	Till (?) Lacustral Silt.
508	Norwich.	" " 1526	Beaver Creek.	"	18 c. Cret. Drift. 1947
503	Minot. ¹⁴	{ 18 d. Laramie 1587	Red Lake.	"	" 1970
		{ Lignite Mines.	Lowry.	"	" 2057
535	Des Lacs.	18 d. Laramie. 1897	Napoleon.	"	" 1955
541	Lone Tree.	" " 1995	Merriam.	"	" 1862
546	Berthold.	" " 2082	Bismark.	"	" 1673
556	Wallace. ¹⁵	" " 2182	Fremont, Elkhorn and Missouri Valley.		
562	Delta.	" " 2258	Elkhorn Valley Line.—Con. ¹⁸		
569	Elton. ¹⁵	" " 2195	444	Chadron, Neb.	19 b. Miocene. 3260
577	Stanley.	" " 2252	449	Dakota Jc.	" " 3245
584	Ross.	" " 2287	461	Wayside.	" " "
589	Manitou.	" " 2278	476	Oelrich, Dak. ¹⁹	18 Cretaceous.
597	White Earth.	" " 2087	485	Smithwick.	18 a. " "
606	Tioga.	" " 2278	500	Buffalo Gap. ²⁰	" " 3282
615	Ray.	" " 2271	516	Fairburn.	" " 3296
622	Wheelock.	" " 2374	528	Hermosa.	" " 3192
631	Spring Brook.	" " 2112	540	Brennen.	" " "
638	Avoca.	Lignite Mines. 1956	548	Rapid City. ²¹	Jura-Trias.
645	Williston.	18 d. Laramie. 1854	555	Black Hawk.	" " "
656	Trenton.	" " 1894	562	Sacora.	" " "
665	Buford.	" " 1944	568	Tilford.	" " "
	Montana Line.		577	Sturgis. ²²	" " 3467
	Cando and St. John Line.		584	Whitewood. ²³	" " 3640
424	Church's Ferry.	D'ft. 18c. Ft. Pierre. 1458	593	Deadwood.	Surveyed. 4545
439	Cando.	" " 1486	597	Pennington.	" " 4972
452	Bisbee.	" " 1600			

12. Geology, notes, and elevations on this line and branches from Shawnee west by Mr. Warren Upham, Assistant Geologist, U. S. Geological survey.

13. The country is all more or less drift-covered to Great Falls, Montana, but is destitute of drift thence to Helena and Butte.

14. The Laramie formation, extending from Minot to Kintyre, contains occasional beds of Lignite.

15.—Terminal moraine drift hills, marking a stage of halt or re-advance of the ice-sheet, are well displayed along the distance of thirteen miles by Wallace, Delta and Elton, a S. E.-N. W. belt of these deposits being there crossed by the railway.

16. Between St. John and Bottineau, the Turtle Mountain area, elevated about 500 feet above the general level, is an extensive outlying tract of the Laramie formation, overspread with irregularly hilly deposits of glacial drift.

17. *Ashley*. The first and second moraines are crossed separately seven to twenty miles N. W. of Leola, where they turn sharply from a south-south-westerly direction to nearly due west. *Ashley* is on a level pebbles plain, covering perhaps twenty square miles. The road between *Ashley* and Napoleon runs mostly in a valley just outside of the first moraine, which is unusually heavily developed.

J. E. T.

18. By Prof. G. E. Bailey of the Dakota School of Mines, Rapid City, S. Dakota.

19. *Oelrich*. Cretaceous, with here and there outliers of Miocene.

G. E. B.

20. *Buffalo Gap*. Bad Lands twenty miles east, the great collecting ground of Prof. Cope and Marsh. Fossil horses, shells with pearl preserved, turtles, etc. Two miles west handsome variegated sandstones, whetstones, fifteen miles west hot springs, tufa.

G. E. B.

21. *Rapid City*. Black Hills, tin mines, twenty miles S. W. Gold, silver, copper, lead, mica and graphite mines; marble, gypsum, brick, fire and potter's clays.

G. E. B.

22. *Sturgis*. Homestake mines, ten miles, Galena Smelters, ten miles.

G. E. B.

23. *Whitewood*. Carbonate and Nigger Hill mining districts. The coal, oil and salt districts of Dakota.

G. E. B.

General Note on the Geology of the Western part of the North American Continent.

It may be useful to those not familiar with the local geology of America, to insert a general account of the well-marked difference between the eastern and western parts of the Continent. Adopting the line of Central Texas, Indian Territory, Kansas, and Eastern Nebraska and Dakota, and extending it in the same general course to the Arctic Circle, we will have North America divided into two great divisions, in each of which the geology of the country has the same general character and each widely different from the other.

The eastern division shows a sub-division into a number of great basins, representing all the older geological formations in their regular stratified order, and each with a carboniferous coal field on its summit, and then the whole area framed on the outside by two or three irregular bands of the Cretaceous, Tertiary and Quaternary formations, and showing also several intermediate lines of Triassic and probably Jurassic.

But on crossing the line above described, we pass from the old to the new geological world, in which the Upper Silurian* and Devonian formations are unknown, and even the Carboniferous appears in so changed an aspect as to be unworthy of the name, inasmuch as it is no longer coal bearing. As our geological table is now numbered, much more than half of it has here become useless in this western district, as none of those formations are there to be seen, and we come into a new geological continent of magnificent distances, covered for thousands of miles chiefly by the Cretaceous and Tertiary, with smaller areas of Triassic and Jurassic formations, with other vast areas of mountains and plains of eruptive and metamorphic rocks, with the minerals peculiar to them, affording but little material for geological notes, and sometimes greatly disturbing and subverting the order of stratification and rendering Metamorphic the Cretaceous and Tertiary. Some of the ranges no doubt contain a central axis of granite and crystalline formations of the older rocks, and in time some small portions of the metamorphic rocks, like those of New England, may prove to have been changed from Palæozoic and other formations well known in the eastern division. A few fossils here and there may show traces of what they once were, but as yet they may be classed under the comprehensive name of Metamorphic.

But the most remarkable point in this description is the vast extent and great persistence and uniformity of these formations of the Far West, so limited in number and spreading from near the Mississippi and Missouri Rivers to the Pacific Ocean, and from the North Pole to the Isthmus of Tehuantepec. This statement gives a correct general impression of the geology of more than half of North America. An examination of this "Geological Railway Guide," along all the lines as yet constructed, and of all the geological maps of the United States and of the Dominion of Canada, and the reports of all travelers, will serve to confirm what has here been stated, and to impress on the mind of the student the important transition he makes in passing west of the Mississippi Valley.

One of the most unfortunate facts in connection with the geology of this western district is, that throughout a large portion of it, especially its central and southern parts, the soil is "alkaline," the rain-fall being less than the evaporation by which soluble salts are brought to the surface, rendering the land unfit for cultivation without irrigation, although portions of it afford pasturage, and there are many lakes and rivers whose waters contain a greater or less per centage of soda salts. The areas, however, are relatively small in which the soil is not able to yield crops, if only water can be supplied to it.

Another point may be worthy of mention, namely, that the study of the formations of the Far West has only been begun, and they are so much more expanded and sub-divided that, for aught we now know, a new geological world may yet be opened, which may greatly enrich the science of geology, modifying our present series of the newer formations, giving us new views of structural and dynamic geology and discovering new forms of ancient life.

It is as true now, as it was when written by Prof. James Hall, thirty years ago, that "our knowledge of the geological formations of the West is so rapidly progressing, and the materials are accumulating in such abundance, that whatever may be presented to-day as new and in advance of previous knowledge, will to-morrow be regarded only as a historical record of our progress." J. M.

TABLE OF THE TERTIARY AND CRETACEOUS FORMATIONS.

From Dr. Edward D. Cope's Report on the Vertebrata of the Tertiary Formations of the West, United States Geological Survey, 1883.

19. TERTIARY.	19 c. Pliocene.	Magalonyx Beds. Equus Beds. Procamelus Beds. Ticholeptus Beds. John Day. White River. Uinta. Amyzon Beds. Bridger. Green River. Wasatch.	18. POST CRETACEOUS.	? Puerco. † 18 d. Laramie.	Puerco. Fort Union. Bear River.
	19 b. Miocene.				
				18 c. Fox Hills.	Fox Hills. Fort Pierre.
				18 b. Colorado.	Niobrara. Fort Benton.
	19 a. Eocene.			18 a. Dakota.	Dakota.

* The Lower Silurian is known in Idaho, Montana, Wyoming, Colorado, New Mexico, Utah, Nevada and Arizona, most largely in the two last named.

† Professor Cope insists there is plenty of evidence, since the publication of his report, that the Puerco is distinct from the Laramie.

Northern Pacific Railroad.¹

Ms.	MINNESOTA.	Alt.	Ms.	MINNESOTA.—Con.	Alt.
.....	St. Paul.	{ 4 a. Trenton, 3 a. St. Peter sandstone. ⁷⁰¹	214	Luce.	1. Arch. h'vy drift ¹³⁷⁰
11	Minneapolis.	" 832	220	Frazer.	" 1384
13	N. Minneapolis.	"	225	Johnson.	" 1393
15	Northtown Junc.	3 a. St. Peter sand s.	230	Detroit.	" 1362
18	Fridley.	" 848	237	Audubon.	" 1303
25	Coon Creek.	" 860	242	Lake Park.	" 1334
29	Anoka.	3 a. Calciferous. 883	248	Hillsdale.	" 1359
36	Itaska.	" 891	254	Hawley.	" 1150
41	Elk River.	2. Primordial. 901	258	Muskoda.	" 1090
45	Bailey's.	" 918	267	Glyndon.	" 924
50	Big Lake.	" 940	269	Tenny.	" 920
57	Becker.	" 976	275	Moorhead.	" 903
64	Clear Lake.	1. Archæan. 997	Red River Low Water. 887		
71	Haven.	" 1016	DAKOTA.		
76	E. St. Cloud.	" 1030			
77	Sauk Rapids.	" 1004	276	Fargo.	1. Arch. h'vy drift. ⁹⁰³
83	Watab.	" 1053	281	Haggart.	" 903
90	Rice's.	" 1059	285	Canfield.	" 903
97	Royalton.	" 1080	289	Mapleton.	9-12. Up. Devonian ⁹⁰³
103	Gregory.	" 1095	292	Greene.	" 913
107	Little Falls.	" 1115	294	Dalrymple.	" 920
112	Belle Prairie.	Taconic. 1130	297	Casselman.	" 930
116	Topeka.	" 1144	303	Wheatland.	" 985
121	Fort Ripley.	" 1158	313	Buffalo.	" 1206
126	Albion.	" 1173	319	Tower City.	" 1170
130	Crow Wing.	" 1186	324	Oriska.	" 1240
138	Brainerd.	" 1208	329	Alta.	" 1425
	Miss. River Low Water.	" 1152	333	Valley City.	18. Cretaceous. 1213
146	Gull River.	" 1189	.....	Cheyenne River	Low Water. 1200
148	Sylvan Lake.	" 1203	342	Hobart.	18. Cretaceous. 1417
151	Pillager.	" 1200	346	Sanborn.	" 1460
156	Bath.	" 1212	349	Eckelson.	" 1444
160	Motley.	1. Archæan. 1223	359	Spiritwood.	" 1477
168	Staples Mill.	" 1250	364	Bloom.	" 1485
170	Dower Lake.	" 1290	369	Jamestown.	" 1295
174	Aldrich.	1327 "heavy drift.	.....	James River Low Water.	1850
178	Verndale.	" 1347	376	Eldridge.	18. Cretaceous. 1540
185	Wadena.	" 1349	386	Windsor.	" 1838
187	Wadena Junc.	" 1350	390	Cleveland.	" 1840
190	Bluffton.	" 1310	398	Medina.	" 1790
193	Amboy.	" 1376	406	Crystal Springs.	" 1790
197	New York Mills.	" 1409	415	Tappen.	" 1760
203	Richmond.	" 1394	420	Dawson.	" 1746
209	Perham.	" 1367			

1. The geology here given of the Northern Pacific Railroad, east of Bismarck, is by Prof. N. H. Winchell, of Minnesota, and that west of Bismarck, through Dakota and Montana, is by Prof. Raphael Pumpelly, whose work, however, was devoted almost wholly to coal explorations, and his journeys were made on horse trails, often off from the route of the railroad, before most of the stations in Montana and Idaho were located. His foot notes are marked R. P., those marked B. T. P. are by his assistant, B. T. Putnam, and those signed G. W. D. are by Dr. George M. Dawson, giving the observations of a passing geological traveler well versed in the geology of the adjoining territory of Canada.

Ms.	Northern Pacific R. R.—Con.	Alt.	Ms.	Northern Pacific R. R.—Con.	Alt.
428	Steele.	18. Cretaceous.	1857		
435	Geneva.	"	1833		
439	Driscoll.	"	1835		
446	Sterling.	"	1865		
453	McKensie.	"	1696		
458	Menoken.	"	1718		
467	Apple Creek.	"	1642		
471	Bismarck. ²	{ 18 d. Laramie, Creta- ceous.	1668		
.....	Missouri River	Low Water.	1616		
476	Mandan.	{ 18 c. Pierre & Fox Hill.	1644		
484	Marmot. ²	"	1729		
490	Sweet Briar.	"	1633		
500	Sedalia.	"	2030		
.....	Summit.	"	2165		
504	New Salem.	"	2161		
507	Blue Grass. ³	18 d. Ft. Union.	2042		
511	Sims. ⁴	"	1960		
516	Almont.	"	1918		
521	Curlew.	"	1955		
528	Kurtz.	"	2023		
533	Glenullen.	"	2070		
538	Eagle's Nest.	"	2098		
547	Knife River.	"	2160		
555	Antelope. ⁵	{ 18 d. Ft. Union Laramie.	2412		
561	Richardton. ⁵	"	2484		
566	Taylor.	"	2486		
574	Gladstone. ⁶	"	2346		
.....	Green River low water.	"	2275		
585	Dickinson.	"	2403		
591	Eland.	"	2434		
597	South Heart.	"	2470		
606	Belfield. ⁷	{ 18 d. Fort Union Laramie, Creta- ceous.	2377		
611	Fryburg.	{ 18 d. Fort Union Laramie, Creta- ceous.	2767		
617	Sully Springs.	"	2647		
620	Scoria. ⁸	"	2505		
625	Medora.	"	2265		
.....	Little Mo. River. ⁹	"	2245		
626	Little Missouri. ⁹	"	2255		
633	Andrews.	"	2476		
641	Sentinel Butte.	"	2767		
MONTANA.					
650	Beach.	{ 18 d. Fort Union Laramie, Creta- ceous.	2754		
.....	Summit.	"	2819		
659	McClellan.	"	2685		
661	Mingusville.	"	2639		
.....	Summit.	"			
671	Hodges.	"	2535		
681	Allard.	"	2299		
691	Glendive. ¹⁰	"	2067		
701	Iron Bluff.	"	2097		
706	Milton.	"	2114		
721	Fallon.	"	2206		
.....	O. Fallon Creek.	"	2145		
731	Terry.	"	2240		
.....	Powder River.	"	2199		
741	Morgan.	"	2245		
751	Ainslie.	"	2272		
761	Dixon.	"	2320		
770	Miles City.	"	2333		
.....	Tongue River.	"	2343		
772	Fort Keogh.	"	2365		
777	Lignite.	{ 18 d. Laramie, Cretaceous, Lignite Mines.	2375		

2. From Bismarck, at Missouri Crossing, to a few miles beyond Marmot Station, numerous exposures in cuttings, and banks of Knife River of Pierre shales, capped in places by Fox Hill sandstones.

G. M. D.

3. Near Blue Grass, detached portions of edge of plateau formed of Fort Union Laramie appear, rocks showing in some places. At Sims, same rocks.

G. M. D.

4. Sims (Bly's Mine). Several seams of lignite, of which two, 4 feet and 7 feet thick, are opened.

R. P.

5. Line runs on up Valley of Knife River, and gradually attains to level of plateau above referred to. This, about Antelope and Richardson, forms a rolling and hilly prairie, which is based directly on Fort Union Laramie, the soil consisting of disintegrated rocks of this formation. No erratic or glacial drift appear anywhere on this plateau, so far as observed.

G. M. D.

6. At Gladstone, descend into Valley of Heart River continued exposures of Fort Union.

G. M. D.

7. From Belfield Station to the Little Missouri, pass through fine "bad land" scenery. Fine display of rocks of Fort Union Laramie. Thin seams of lignite, which in many places have been burnt out, reddening the surrounding rocks. Large masses of silicified wood in some places.

G. M. D.

In entering the Bad Lands of the Little Missouri, the change in the scene is startling, and the appearance of the landscape wholly novel and singularly grotesque. There are thousands of these buttes, and you ride in a fast train for an hour in the midst of red, gray, black, brown and blue towers, pyramids, peaks, ridges, domes and castellated heights, turrets, battlements, sharp spires, grotesque gargoyles and huge projecting buttresses—an amazing jumble of weird architectural effects, that startle the eye with suggestions of intelligent design. It is a region of extraordinary interest to the tourist and artist.

E. V. SMALLEY.

8. Scoria. In Bad lands or Pyramid Park. Near here are extensive burning seams of lignite.

R. P.

9. Little Missouri. Several seams of lignite, of which one, 7 feet thick is opened.

R. P.

At Little Missouri, high banks with good exposures of Fort Union Laramie rocks.

10. Beyond Glendive, following the Valley of the Yellowstone, numerous banks showing Fort Union, thin lignite seams and much massive soft sandstone.

G. M. D.

Ma.	Northern Pacific E. R.—Con.	Alt.	Ma.	Northern Pacific E. R.—Con.	Alt.
782	Horton.	{ 18 d. Laramie, Cretaceous, Lignite Mines. 2390	.....	Summit of Mt. over Tunnel.	5335
790	Hathway.	" 2426	1046	West End.	18 U. Cre. Juras. & 5340
802	Rosebud.	" 2460	1046	Timber Line. ¹⁵	" [Trias. 5500
815	Forsyth.	" 2512	1048	Mountain Side.	" 5275
825	Howard. ¹¹	18 c. Fox Hill. 2559	1049	{ Rock Cañon ¹⁹ Chestnut. ²⁰	{ 17. Jurassic, 5225 16 Carboniferous.
836	Sanders. ¹¹	" 2598	1051	Gordon.	" 4905
847	Myers. ¹²	" 2651	1054	Fort Ellis.	20. Quaternary. 4860
857	Big Horn.	" 2688	1057	Bozeman. ¹⁶	" 4752
863	Custer.	" 2725	1067	Belgrade.	" 4435
872	Riverside.	" 2777	1072	Central Park.	" 4295
880	Bull Mountain.	" 2840	.....	Gallatin River.	" 4280
888	Pompey's Pillar. ¹³	" 2869	1076	Hamilton.	" 4240
896	Clermont.	" 2951	1085	Gallatin.	" 4030
904	Huntley.	18 c. Fox Hill. 3012	1096	Magpie.	{ 14. Carboniferous. 2. Cambrian. 3980
.....	1st Cross'g Yel. River.	" 3077	1103	Painted Rock.	" 3952
917	Billings. ¹³	{ 18 c. Fort Pierre, with Bluffs of Fox Hill Group. 3115	1112	Toston.	" 3919
930	Laurel.	" 3258	1122	Townsend.	{ 20. Quaternary, Lake Basin. 3809
940	Park City.	18. Cretaceous. 3385	.....	Missouri River.	" 3791
953	Rapids.	" 3515	1125	Bedford.	" 3882
957	Stillwater.	" 3570	1137	Placer.	" 4290
965	Merrill.	" 3658	.....	Summit.	" 4345
968	Reedpoint.	" 3685	1144	Clasol.	" 4123
.....	2d Crossing Yel. River.	" 3674	1149	Jefferson Junc.	" 3887
984	Greycliff.	" 3845	.....	Prickly Pear Ck.	" 3865
998	Big Timber.	" 4070	1151	Prickly Pear.	" 3878
1012	Springdale. ¹⁴	" 4188	1155	Helena. ²¹	" 3930
1019	Elton.	" 4280	.....	10-Mile Creek.	2. Cambrian. 3875
1024	Mission.	" 4355	1163	Birdseye.	" 4025
.....	3d Crossing Yel. River.	" 4435	1168	Butler.	" 4725
1032	Livingston. ¹⁵	18. Up. Cretaceous 4485	1176	Mullan (Tun.)	{ 14. L. Carbon. Lime- stone & Granite 5545
1037	Coal Spur. ¹⁶	Juras. & Trias.? 4735	.....	Summit. ²²	{ 18. Cretaceous, with Coking Coal. 5873
1041	Hopper's. ¹⁷	" 5175	1184	Elliston.	{ 14. Carboniferous, 18. Cretaceous. 5036
1044	Muir.	" 5500			
.....	Belt Range Tunnel.	" 5565			

11. Before reaching *Howard*, and between that station and Saunders, almost continuous exposures of massive yellowish soft sandstone, evidently Fox Hill, and nearly horizontal. G. M. D.

12. In a cut at *Meyer's*, and just beyond that station, a slight undulation brings the top of the Pierre into view. The base of the sandstone becomes interbedded with dark shales. G. M. D.

13. Similar sandstones, with top of Pierre occasionally showing below them, extend all along the Yellowstone Valley to *Billings*, and beyond. At *Billings* they form bold cliffs behind the town. The so-called Pompey's Pillar, near station of same name, is an isolated mass of these sandstones. G. M. D.

14. Near *Springdale*, the rocks become disturbed for the first time, and dip at high angles. Jurassic-Triassic, according to Hayden's map. (?)

Beyond *Springdale*, fine views of Little Belt Mountains to north, and north end of Yellowstone range to south, the former composed (by map) of volcanic rocks, with a belt of Carboniferous tilted up around them, the latter of Metamorphic rocks, surrounded by Silurian, Carboniferous and Jurassic-Triassic. G. M. D.

15. *Livingston*. Branch railroad to Yellowstone National Park. Lower cañon of the Yellowstone in sight. It is cut across the arch of a pitching anticlinal giving a fine section of Carboniferous, Jurassic, Triassic (?) and Cretaceous fossiliferous beds. R. F.

16. From *Livingston* to *Bozeman Tunnel*. Cretaceous and possibly Jurassic-Triassic rocks, much disturbed, and at all angles to vertical. G. M. D.

17. *Hoppers*. Seams of Cretaceous coking coal are worked a mile or so south of the tunnel. R. P.

18. At *Timber Line*, just west of Bozeman Tunnel, spur track to coal mine, which I am informed yields most of coal now used on line. G. M. D.

19. *Rock Cañon*, just beyond Timber Line, seems to show Carboniferous limestones and other old rocks nearly on edge. G. M. D.

20. *Chestnut*. Several seams of coking coal, much crushed. Carboniferous, Jurassic and Dakota exposed in a cañon cut across the end of an anticlinal arch. R. F.

21. *Helena* is built in a gulch, which has been washed with great profit for gold. R. F.

22. *Summit*. Cretaceous seams of coking coal. R. F.

Ms.	Northern Pacific R. R.—Con.	Alt.	Ms.	Northern Pacific R. R.—Con.	Alt.
1198	Avon.	{ 14. Carboniferous. 18. Cretaceous. 4675	1344	Victor.	{ 2. Cambrian contain- ing Plioc. or Quat. Lake Basin. 2455
1206	Garrison. ²	{ 18. Cretaceous. 4815 14. Carboniferous.	1350	Paradise.	" 2480
1207	Lloyd. ²⁴	" 4295	1357	Horse Plains.	" 2463
1214	Gold Creek. ²⁵	" 4203	1364	Weeksville. ³¹	" 2440
1227	Drummond. ²⁶	{ 14. Carboniferous. Cañon in Carbonif. limestone. 3943	1371	Eddy.	" 2415
1239	Bearmouth.	" 3787	1378	Woodlin.	" 2455
1247	Carlan.	{ Deposit of Traver- tine. 3683 2. Cambrian, with eruptive-dykes.	1381	Thompson Fs. ³²	" 2434
1255	Bonita. ²⁷	" 3564	1382	Allen. ³³	" 2410
1262	Wallace.	" 3438	.....	{ 2d Crossing Clark's Fork.	" 2298
1269	Turah.	" 3308	1387	Belknap.	" 2405
1279	Missoula. ²⁸	{ 18. Cretaceous basin with seams of lig- nite. 3195	1394	White Pine.	" 2372
1286	De Smet.	" 3213	1404	Trout Creek.	" 2275
1296	Evaro. ²⁹	2. Cambrian. 3946	1410	Tuscor.	" 2235
1307	Arlee.	{ Lake bas. prob- ably 19 f. Pli- 2952 ocene or Quat- ernary. 2507	1419	Noxon.	" 2186
.....	Jocko Creek.		1429	Heron.	" 2261
1316	Ravalli. ³⁰	{ 2. Cambrian contain- ing Plioc. or Quat. Lake Basin. 2497	1435	Cabinet. ³⁴	" 2187
1323	Jocko.	" 2493	1442	Clark's Fork.	" 2086
1330	Duncan. ³¹	" 2462	.....	1st Crossing Cla rk's Fork	" 2055
1338	Perma.		1452	Hope.	" 2108
.....	8d Crossing Cla rk's F'k.		IDAHO TERRITORY.		
			.....	{ Lake Pend d'Oreille. ³⁵	{ Clay, Slate and 2059 Trap.
			1457	Kootenai.	" 2080
			1467	Sand Point. ³⁶	{ Granite & Gneissic area. 2100
			1473	Algoma.	" 2214
			1480	Cocolalla.	" 2224

23. Powell's peak on the south occasionally visible between *Garrisons* and *Drummond*, has a granite core, overlaid by Cambrian slates, Carboniferous limestone, and Cretaceous strata. B. F. P.

24. *Lloyd*. Cretaceous, with eruptive; Carboniferous limestone in mountains to the north. B. F. P.

25. *Gold Creek*. First discovery of gold in Montana is said to have been made near here. B. F. P.

26. *Drummond*. Lower (?) Cretaceous fossils in Colerley's hollow, 5 miles southeast of *Drummond*. B. F. P.

27. *Bonita*. Bitter Root Mountains seen towards the south are granite; Cambrian slates in foot hills. B. F. P.

28. Near *Missoula* (Evaro), the rocks evidently "Cambrian." These continue in a series of undulations, but often for long distances at low angles, to *Sand Point*. "Cambrian" rocks, consisting of hard quartzites, shales, slate, etc. G. M. D.

29. *Evaro*. Probably Pliocene or Quaternary, or 2. Cambrian. R. P.

30. *Ravalli*. A ride of about 12 miles to MacDonald's Peak, one of the grandest and wildest mountain masses on the continent, remarkable for its great amphitheatres and lakes and high cascades. Here is exposed a great thickness of Cambrian overlaid by lower Carboniferous. The ascent is along the crest of a fine moraine, on a horse trail of the Northern Transcontinental Survey. R. P.

31. *Duncan* to *Weeksville*. Valley of Clark's Fork is between Cambrian walls, and contains Pliocene or Quaternary lake basins. R. P.

32. *Thompson's Falls*. I have seen no drift in Montana, Idaho and Washington Territory, east of the Cascades, that appeared to me to be truly glacial drift. Moraines occur along the great ranges as remnants of local glaciation; and erratics which may have been brought by icebergs, agreeably to Dr. G. M. Dawson's theory, occur at many points on the high plains at the eastern base of the Rocky Mountains, south of the boundary. R. P.

33. *Allen*. Glaciers exist on a moderate scale in the Wind River Mountains, and others were discovered by the writer in 1883, on the headwaters of the Flathead River in the main range of the Rocky Mountains, just south of the British boundary. Very large glaciers exist on Mount Rainier, in the Cascades, and are accessible by the horse trail of the Northern Transcontinental Survey from Wilkeson. R. P.

34. *Cabinet*. The valley of Clark's Fork is chiefly between Cambrian walls, and contains old lake basins of Quaternary, and perhaps also of Tertiary age. R. P.

35. *Lake Pend de Oreille*. The islands in south end of Lake Pend de Oreille are finely glaciated. R. P.

36. Shortly after passing *Sand Point*, enter a granitic or gneissic area. These rocks continue, apparently at least in the hills, to near Spokane Falls, where basaltic rocks set in, and characterize the whole Columbia plain. G. M. D.

Northern Pacific Railroad—				OREGON.			
Ms.	Continued.		Alt.	Ms.	Oregon, R. W. & Navig. Co.'s R. R.		Alt.
1490	Granite.	{ Granite & Gneissic area.	2290	1715	Cold Springs.	{ Vol. bas. rocks over the whole Columbia plain.	367
1495	Athol.	"	2210		"	"	303
1499	Chilco.	"	2450	1726	Umatilla Junc.	"	303
1509	Rathdrum.	"	2210	1733	Stokes.	"	303
1519	Idaho Line.	"	2128	1751	Castle Rock.	"	248
WASHINGTON TERRITORY.				1762	Willows.	"	334
.....	Spokane River.	{ Granite & Gneissic area.	1926	1771	Alkali.	"	
1528	Trent.	"	1989	1779	Blalock.	"	220
1537	Spokane Fa's. ³⁶	{ Volcanic basaltic rocks.	1910	1794	John Day's.	"	190
.....	Hangman Cr'k.	"	1793	1801	Grant's.	"	180
1545	Marshall. ³⁹	{ Volcanic basaltic rocks over the whole Columbia plain.	2184	1811	Celilo.	"	180
1553	Cheney.	"	2340	1824	The Dalles. ³⁷	"	106
1564	Stevens.	"	2282	1833	Rowena.	"	140
1577	Sprague.	"	1908	1847	Hood River.	"	100
1587	Harrison.	"	1950	1867	Cascade L'ks. ³⁸	"	108
1601	Ritzville.	"	1825	1871	Bonneville.	"	60
1618	Lind.	"	1363	1879	Oneonta.	"	47
1628	Providence.	"	1530	1880	Multnomah Fal. ³⁹	"	45
1638	Twin Wells.	"	1075	1884	Bridal Veil.	"	46
1646	Palouse Junc.	"	858	1887	Rooster Rock.	"	45
1656	Lake	"	677	1895	Troutdale.	"	60
1665	Eltopia.	"	600	1910	E. Portland.	"	35
1675	Glade.	"	500	1911	Albina.	"	35
1685	Ainsworth.	"	351	1912	Portland. ⁴⁰	"	43
... ..	Snake River.	"	328	Rocky Mountain R. R. of Montana.			
1686	S. Ainsworth.	"	356	Yellowstone Park Line. ⁴⁰			
1698	Wallula Junction, Ore.	"	326	0	Livingston.	18. Cretaceous.	4485
				10	Brisbin. ⁴¹	{ 19. Post Tertiary, (Lake Deposit) ^{42,43}	4545
				20	Chicory.	"	4915
				31	Dailey's.	"	5070
				41	Sphinx.	"	5179
				51	Cinnabar.	"	

37. At *Dalls*, basaltic lava in numerous supposed flows forms the hills.

38. At *Cascades*, tufaceous and agglomerate beds appear, and beds of rounded gravels underlie the volcanic materials. Basalts of hills in light, broad undulations. G. M. D.

39. *The Volcanic Region* The portion of the Northern Pacific Railroad through the vast volcanic region in Washington and Oregon, affords but little material for interesting geological notes. A recent report of Mr. J. C. Russel, in the 4th Annual Report of the U. S. Geological Survey, gives some descriptions of the little known part of Southern Oregon, south of the railroad. Its rocks are almost wholly volcanic, and spread out in great sheets of lava that once formed a broad, smooth table-land; but in later times it has been broken by faults, so characteristic of the Great Basin region, and thus divided into long, narrow blocks, stretching north and south, and tilted by very recent displacements so as to expose fresh precipitous scarps that have not yet sensibly worn back from the fault lines. In the Warner Valley, for example, the orographic blocks of the dark volcanic rock, miles in length, are literally tossed about like the cakes of ice in a crowded floe, their upturned edges forming bold palisades that render the region almost impassable, which, with the branching fault cracks, combine to make a region of the wildest and roughest description. At present the waters have retreated from the terraces and benches that marked their former level, some, like Summer and Albert Lakes, are permanent sheets of very saline water, but the more numerous are fresh. Mr. Russel finds no evidence of either local or general glaciation in the region he examined. The volcanic history of Oregon and Washington is far from being understood. The points that may be claimed as centres of eruption are rare, so far as has yet been observed, and in only a few instances can the overflows of lava be traced to their sources. Captain C. E. Dutton reports immense flows of lava in the Sandwich Islands, from surprisingly small openings. But those were down the sides of a steep mountain. Neither is there definite and satisfactory evidence obtained that these immense lava fields originated from fissure eruptions. With the exception of very recent deposits of lacustrine origin, nothing is to be seen but volcanic rocks in sections or regularly stratified layers, which from a distance resemble sedimentary beds, but on examination one finds them to be wholly of igneous origin. These black volcanic rocks are composed of rhyolite, together with large quantities of obsidian or volcanic glass. No evidence of volcanic craters were observed, and no basaltic overflows were seen to indicate centres of recent volcanic action. Major Powell reports this region as containing the grandest and most extensive display of volcanic phenomena now known in any part of the world, and the investigation of it promises to supply matter of great importance and instruction to geologic science. We do not yet know even

Ms.	Duluth & Brainerd Line.	Alt.	Ms.	N. P. Fergus & Black Hills R. R.	Alt.
0	Duluth, Minn.	1. Cupriferous. 608	0	Wadena.	20. Heavy drift 1349
23	N. P. Junction.	Potsdam Taconic. 1080	1	Wadena Junc.	with many 1350
28	Pine Grove.	" 1235	10	Deer Creek.	glacial lakes 1394
33	Norman.	" 1315	14	Parkton.	and moranic 1394
39	Corona.	" 1301	18	Henning.	hills. 1436
45	Cromwell.	Taconic. 1304	24	Vining.	" 1389
51	Wright.	" 1307	29	Clitheral.	" 1346
57	Tamarack.	" 1269	33	Battle Lake.	" 1354
66	McGregor.	" 1226	39	Maplewood.	" 1360
75	Kimberly.	" 1235	41	Southwick.	" 1342
87	Aitken.	" 1207	52	Fergus Falls.	" 1183
92	Cedar Lake.	" 1220	59	French.	" 1085
97	Deerwood.	" 1275	60	Ames.	" 1063
108	Jonesville.	" 1236	68	Everdell.	" 993
114	Brainerd.	" 1208	77	Breckenridge,	" 960
Pacific & Cascade Divisions.			78	Wahpeton.	" 968
0	Portland, Ore.	Volcanic. 33	86	Ellsworth.	" 960
38	Kalama, Wash.	" 82	92	Mooreton.	" 967
59	Castle Rock.	" 328	98	Barney.	" 1031
75	Winlock.	" 204	105	Wyndmere.	" 1060
88	Chehalis.	" 207	120	Milnor.	" 1095
92	Centralia.	" 315	Fargo & Southwestern Division.		
104	Tenino.	" 387	0	Fargo.	{ 20. Lacustrine silt of Lake Agassiz, 908
118	Yelm Prairie.	" 324	4	Cotters.	" 909
134	Lake View.	" 31	10	Horace.	" 917
143	Tacoma.	" 51	19	Davenport.	" 921
152	Puyallup.	" 67	28	Leonard.	" 1045
153	Puyallup Junc.	" 80	41	Sheldon.	20. Till. 1078
155	Sumner.	" 110	50	Buttzville.	" 1171
159	Struck Junc.	" 95	56	Lisbon.	" 1089
156	Alderton.	" 855	68	Marshall.	{ 20. Till and 4th Mo- raine. 1341
175	Wilkeson.	" 1152	76	Verona.	" 1334
177	Carbonado, Wash.	"	88	La Moure.	18. Cret. & Till. 1305
Wisconsin Division.			Sanborn, Cooperstown & Turtle Mountain Railroad.		
0	Lake Superior.	20. Red Clay Drift. 602	0	Sanborn.	{ 18. Cret., under very heavy drift. 1460
2	Ashland, Wis.	" 669	9	Odell.	" 1441
6	Omaha Junc.	" 642	18	Dazey.	" 1448
24	Summit.	" 1178	27	Hannaford.	" 1437
64	Superior.	" 608	36	Cooperstown.	" 1447
76	Walbridge.	" 813			
79	Carlton.	" 938			
88	N. P. Junction.	" 1080			

the extent of this vast volcanic region in Idaho, Washington, Oregon, Nevada and California, but it has been estimated by Prof. Joseph LeConte, at from 200,000 to 300,000 square miles, and its age, he thinks, is Tertiary and probably Miocene. After these vast fields of lava had cooled and consolidated, then came another revolution that affected a region equally great, but situated mostly to the south of it, a force or series of forces, the power and extent of which are utterly beyond the limits of our conception, which broke the earth's crust into thousands of fragments, which were depressed and buried or upheaved into mountain ridges. It will be, when fully explored, one of the wonders of geology for its extent, its remarkable structure, and the mystery of its origin.

40. *Yellowstone Park Line of Rocky Mountain Railroad of Montana*; by Professor Wm. M. Davis, of Harvard College.

41. *Brislin*. In passing up lower Cañon of Yellowstone, Jurassic (fossils just outside and west of entrance), Carboniferous limestone (very heavy, poor in fossils), and Lower Silurian (Potsdam), are crossed east of river above cañon, contact of Lower Silurian and Archean. (Hayden.)

The altitudes on the Northern Pacific Railroad were furnished by A. Anderson, Engineer in Chief. They differ slightly from those in Gannett's Dictionary of Altitudes, in Minnesota, but agree with them in Montana, and all west of that. The original datum point was obtained by taking the assumed low water of Lake Superior at 602, as determined by Captain Bayfield, of the Royal Navy, in 1825, by barometrical observations, which have been confirmed by the United States Engineers. From the west, the datum is mean low water of Puget Sound.

Montana. ¹			Ms.	Montana Central Railroad.	Alt.
St. Paul, Minn. and Manitoba Ry. ²				0 Great Falls.	221
Ms.	Continued from North Dakota.			14 Ulm.	
673	Willows. ⁴	18 d. Laramie	1889	28 Cascade.	
682	Kila.	"	1955	36 Hardy.	
689	Lanark.	"	1976	44 Mid Cañon.	
697	Culbertson.	"	1913	51 Craig.	
703	Blair.	"	1920	59 Wolf Creek.	
711	Calais.	"	1934	66 Wilder.	
720	Brockton.	"	1945	68 Mitchells.	
730	Poplar.	"	1955	80 Silver.	
739	Chelsea.	"	1980	Marysville.	
745	Macon.	"	1976	89 Iron.	1 a. Laur. 1 b. Huron
751	Wolf Point.	"	1995	97 Helena.	" "
762	Oswego.	"	2018	108 Montana City.	
769	Lenox.	"	2072	113 Clancy.	
775	Kintyre. ³	"	2082	114 Alhambra.	
181	Milk River.	18 c. Ft. Pierre.	2048	115 Winslow.	
786	Nashua.	"	2060	119 Jefferson.	
794	Whately.	"	2086	121 Corbin.	
801	Glasgow.	"	2087	125 Wickes.	
805	Stockholm.	"	2092	133 Boulder.	
811	Tampico.	"	2105	141 Basin.	
818	Vandalia.	"	2120	145 Bernice.	
825	Hinsdale.	"	2162	153 Elk Park.	
834	Beaverton.	"	2167	162 Woodville.	
839	Saco.	"	2175	171 Butte.	
849	Ashfield.	"	2205		
857	Bowdoin.	"	2209		
866	Malta.	"	2242		
871	Exeter.	"	2254		
877	Wagner.	"	2258		
884	Dodson.	"	2279		
889	Eureka.	"	2301		
897	Savoy.	"	2324		
902	Wayne.	"	2332		
911	Harlem.	"	2359		
919	Zurich.	"	2368		
926	North Fork.	"	2381		
932	Chinook.	"	2401		
940	Yantic.	"	2431		
947	Toledo.	"	2455		
954	Havre.	"	2472		
961	Assiniboine.	"	2576		
968	Laredo.	"	2627		
978	Box Elder.	"	2669		
989	Big Sandy.	"	2690		
994	Verona.	"	2708		
1001	Cairo.	"	2837		
1008	Dry Fork.	"	2984		
1018	Marias.	"	2561		
1023	Teton.	"	2626		
1030	Benton.	"	2850		
1036	Tunis.	See Note 5.	2957		
1043	Sidney.	"	3098		
1048	Flowerree.	"	3203		
1056	Portage.	"	3413		
1065	Watson.	"	3470		
1073	Great Falls. ⁴	"	3812		
				Washington.	
				Northern Pacific Railroad ⁵ .—(Con.)	
				Cascade Division.	
				0 Pasco Jc. ⁷	See Notes.
				3 Kennewick	"
				41 Prosser.	"
				53 Mabton.	"
				71 Toppenish.	"
				90 Yakima.	" 991
				127 Ellensburg.	" 1511
				152 Clealum. ⁸	"
				158 Nelson's.	"
				165 Easton.	See Note 9.
				173 Martin.	"
				175 Stampede. ¹⁰	"
				183 Weston.	"
				190 Hot Springs.	"
				203 Eagle Gorge.	"
				211 Palmer.	See Note 11.
				220 Enumclaw.	"
				223 Buckley.	"
				227 Cascade.	"
				228 South Prairie.	"
				241 Alderton.	"
				243 Meeker.	"
				245 Puyallup.	" 6
				254 Tacoma. ¹⁴	" 9

Spokane and Palouse Ry.			Alt.	Olympia and Chehalis Valley Railroad.			Alt.
Ms.				Ms.			
0	Spokane Falls.	{ Ter. Erup., whose limit on the S. E. is undetermined.		0	Olympia.	Drift.	
9	Marshall Jc.			2	Turnwater.	"	
20	Spangle.			6	Bush Prairie.	"	
35	Rosalia.			8	Plum.	"	
46	Oakesdale.			10	Shurlock.	"	
52	Belmont.			12	Gillmore.	"	
68	Palouse.			15	Tenino.	"	
79	Whelan.			Puget Sound Shore Railroad.			
84	Pullman.			0	Seattle.	Drift.	
103	Uniontown.			10	Black River Jc.	"	
112	Genesee.			16	Kent.	"	
Central Washington.				20	Slaughter.	"	
				23	Stuck Jc.	"	
				Columbia & Puget Sound Railroad.			
0	Cheney.	{ Tertiary Eruptives, Great Plain of the Columbia.		0	Seattle.	Drift.	
10	Medical Lake.			10	Black River Jc.	"	
15	Deep Creek.			13	Renton.	{ Upper Cretaceous. Lignite.	
26	Fairweather.			21	Coal Creek.		
34	Mondovi.			19	Cedar Mt.	?	
41	Davenport.			23	Maple Valley.	?	
Seattle, Lake Shore & Eastern.				31	Black Diamond.	{ Upper Cretaceous. Bituminous Coal.	
0	Seattle.	See Note 12.		84	Franklin.		"
5	Ross.	"		Oregon Railway and Navigation Co.			
6	Fremont.	"		230	Pendleton, Or.	See Note 13.	1070
11	Yesler.	"		241	Eastland.	"	1425
18	Terence.	"		244	Adams.	"	1520
21	Winsor.	"		248	Athena.	"	
28	Snohomish Jc.	"		252	Weston.	"	1855
29	Earle.	"		258	Blue Mt.	"	
36	Snohomish.	"		267	Milton.	"	
27	York.	"		271	Spofford.	"	
33	Adelaide.	"		278	Walla Walla, W.	"	926
42	Gilman.	"		284	Valley Groove.	"	878
49	Preston.	"					
53	Falls City.	"					

1. The large number of railroads constructed in the "North West" since the preparation of the chapter on the Northern Pacific, has necessitated the addition, out of the proper order, of some lines properly belonging in that chapter. Other new lines are also added.

2. By Mr. Warren Upham, Assistant Geologist U. S. Geological Survey.

3. *Kintyre*. See note 14, N. & S. Dakota.

4. See note 13, N. & S. Dakota.

5. The formations are older than the Cretaceous, including probably Jurassic or Triassic and Carboniferous.

6. The remainder of the chapter is by Mr. Bailey Willis, Assistant U. S. Geologist. The elevations, so far as given, are furnished by Mr. Henry Gannett, Chief Geographer, U. S. Survey. Much of the region traversed by these railroads has not been carefully surveyed, and the assignments of formations and the notes are necessarily of a general character. See note 39 Northern Pacific R. R.

7. Twenty miles west of Pasco, the road leaves the volcanic flows of the Great Plain of the Columbia and enters Yakima Prairie. Thence to ten miles beyond Ellensburg the route is through Ahtanam, Wenass, and Kittitass Prairies and through the cañons of the Yakima, which separate the valleys; the Prairies are Tertiary (?) lake beds, drained through the cañons which the river has cut in volcanic rocks, also Tertiary.

8. Branch from Cleatum to Roslyn coal mine. Coals of Puget group, (Upper Cretaceous.) B. W.

9. The road runs across the main range of the Cascades, which consists of granite, Palaeozoic crystallines and Cretaceous strata, folded and afterwards cut through and overflowed by Tertiary eruptives. The Cretaceous rocks are sandstone and shale, resting on a basal conglomerate. The volcanic rocks preponderate in this section, but give way to granite northward beyond Snoqualmie. B. W.

10. The pass is 3,980: the tunnel 2,835 above tide.

Oregon Railway and Navigation Co.			Oregon Railway and Navigation Co.		
Ms.	Continued.	Alt.	Ms.	Continued.	Alt.
287	Hadley, Wash.	See Note 13. 848	448	Truax.	See Note 13.
291	Berryman.	1011	455	Rockford.	2580
294	Highland.	1181	0	Bolles Jc.	2390
298	Prescott.	1086	3	Waitsburg.	1185
302	Bolles Jc.	1165	6	Huntsville.	1273
306	Menoken.	1298	10	Long's.	1356
314	Alto.	1907	13	Dayton.	1472
320	Relief.	1096	0	Starbuck.	1606
325	Starbuck.	645	7	Delaney.	645
329	Grange City.	522	14	Chard.	885
333	Ripasia.	530	24	Zumwalt.	1154
346	Hay.	1100	29	Pomeroy.	1591
353	Meeker.	1503	0	Connell.	1900
358	La Crosse Jc.	1478	9	Sulphur.	839
361	Sutton.	1505	18	Kahlotus.	757
368	Winona Jc.	1492	29	Washtuona.	896
374	Endicott.	1700	39	Hooper.	1012
385	Diamonds.	2045	48	Pampa.	1084
389	Mockonema.	2180	53	La Crosse Jc.	1850
391	Crest.	2278	0	Colfax.	1478
394	Colfax.	1961	7	Riverside.	1974
400	Glenwood.	2075	9	Shawnee.	2175
406	Elberton.	2185	12	Guy.	2194
412	Garfield.	2470	18	Pullman.	2244
421	Farmington.	2614	24	Garrison.	2345
427	Seltice.	2525	28	Moscow.	2500
432	Tekoa.	2490			2589
439	Latah.	2442			

11. Drift Plain, with occasional outcrops of Tertiary eruptives and river cañons cut down into Upper Cretaceous (Puget Group) coal measures. B. W.

12. This road is probably all on drift (glacial) with occasional outcrops of sandstones of Puget group, coal measures. B. W.

13. The line lies chiefly through regions of volcanic flows, and the conditions were favorable for the formation of lake deposits during both Tertiary and Quarternary time. It is probable, though not known to be true, that the agricultural lands of this region are very largely dried lake beds. Specific information as to localities is not at present obtainable. The same statement is also applicable to the other line of the O. R. & N. Co., east of Umatilla. B. W.

14. The following note is on the branch of the Northern Pacific to Carbonado. (See page 263). At South Prairie, Wilkeson, and Carbonado, bituminous coking coal is mined. This is the only producing field of coking coal on the coast; the Strata are Upper Cretaceous, "Puget Group." Similar trip south of Alaska. B. W.

Wilkeson is the starting point for parties visiting the glaciers of Mt. Tacoma, distance 35 miles over a good horse trail; time required for trip, including ascent over snow fields to 9,500 feet above sea, in three days; the route is through the great forests of the region in their most typical development, and the glacial phenomena are of more striking interest and beauty than those afforded by any.

Some suggestions as to geology on the Oregon and Washington Railway, in Washington, may be gathered by the traveler from the foregoing notes. Nothing more definite can be obtained. J. R. M.

The following altitudes, taken from Mr. Gannett's Dictionary of Altitudes, are of interest. Mt. Baker, 10,827 feet; Mt. Hood, 11,225; Mt. Jefferson, 16,500; Mt. Olympus, 8,138; Ranier, (Tacoma) 14,444; Mt. Skomogan, 8,400; Mt. Tehopahk, 7,200; Mt. St. Helena, 9,750. J. R. M.

Missouri.¹

GEOLOGICAL FORMATIONS OF MISSOURI.

20. Quaternary, Alluvium, Bluff or Loess, and Drift.	5-7. Upper Silurian, 7. L. Helderberg.
19. Tertiary, in Southeast Missouri.	5. Niagara.
18. Cretaceous,	2-4. Lower Silurian, 4. c. Hudson River.
14. Coal Measures, 14 c. Upper.	4. b. Galena or Receptaculite l.s.
" " 14 b. Middle.	" " 4. a. Trenton and Black River.
" " 14 a. Lower.	" " 3 a. Calcifer's.
13. L. Carboniferous	" " { 1st Magnesian.
or Sub-Carb., 13 e. Chester group.	" " { Saccharoidal s.s.
" " 13 d. St. Louis.	" " { 2d Magnesian l. s.
" " 13 c. Keokuk.	" " { 2d Sandstone.
" " 13 b. Burlington.	" " { 3d Magnesian l. s.
" " 13 a. Kinderhook or Chouteau.	" " { Lower Magnesian l. s. and s. s.
10. Devonian, 10c. Black Slate (Genesee?)	" " 2 b. Potsdam.
5-7. Upper Silurian, 8 Oriskany.	1 b. Huronian.
	1 a. Laurentian.

Ms. Hannibal and St. Joseph Railroad. Alt.		Ms. Hannibal and St. Joseph R.R.—Cont. Alt.	
0 Hannibal.	470	0 Quincy.	18 a. Sub-Carb.
6 Bear Creek.	589	9 North River.	18 b. " 479
10 Barkley.	637	15 Palmyra.	" 684
15 Palmyra Jo.	649		
19 Woodland.	679	206 St. Joseph.	14 c. Up. Coal Mrs.
80 Monroe.	734	211 Lake.	20. Alluvial
42 Lakenan.	739	217 Halls.	"
53 Lentner.	790	222 Rushville.	" & 14 c. U.C.M.
59 Clarence.	824	226 Winthrop.	"
70 Macon.	867	172 Cameron.	14 c. Up. Cl. Mrs. 1026
79 Callao.	812	187 Lathrop.	" 948
90 Lingo.	809	201 Kearney.	" 835
104 Brookfield.	757	211 Liberty.	" 846
109 Laclede.	757	218 Arnold.	" 739
121 Wheeling.	740	226 Kansas City.	" & 20 748
130 Chillicothe.	764		
140 Mooresville.	921	Wabash, St. Louis and Pacific R. R.*	
150 Nettleton.	958	0 St. Louis.	18 d. St. Louis group.
156 Hamilton.	987	6 Bartmer.	14 b. Mid. Coal Mrs.
168 Kidder.	1017	14 Graham's.	" [by 20.
172 Cameron.	1036	22 St. Charles.	18 d. St. Lo. group, cov'd
177 Osborn.	1044	80 Dardenne.	20. Quaternary.
185 Stewartsville.	958	88 Perruque.	13 c. and d.
200 Saxton.	881	48 Foristell.	18 a. & b. rests on 10 c.
		58 Warrenton.	" on 4 a. & 4 b.
206 St. Joseph.	888	68 Jonesburg.	18 a. and 4 a. Trenton.
		77 New Florence.	18 a.

1. By Professor G. C. Broadhead, late State Geologist of Missouri.

2. On W. St. L. & P. R. R., in Warren and Montgomery Counties, we pass within a few miles from Carboniferous, chiefly Lower part of Sub-Carboniferous through thin outliers of Devonian to the Receptaculite (Galena Limestone) and Trenton and Black River to the 1st Magnesian limestone and Saccharoidal sandstone; the latter well developed and very suitable for glass-making purposes—thick deposits and easy to crush. It is the equivalent of the St. Peter's sandstone.

Wabash, St. Louis and Pacific Railroad.			Wabash, St. Louis and Pacific R. R.—Cont.		
Ms.	Continued.	Alt.	Ms.	Glasgow Branch.	Alt.
0 Wellsville.	14 a. Lower Coal Mrs.		0 Salisbury.	721 14 a. Lower Coal Mrs.	
103 Benton City.	"		15 Glasgow.	630 " base.	
108 Mexico.	"	828	St. Louis and Omaha Line.		
114 Thompson.	"		St. Louis.		
122 Centralia.	"	873	0 Brunswick.	644 14 a. Lower Coal Mrs.	
130 Sturgeon.	"	847	38 Chillicothe.	14 b. Mid. Cl. Mrs. 744	
140 Renick.	" 4 ft. coal.		64 Gallatin.	"	
146 Moberly.	"	833	80 Patton's b'gh.	772 14 c. Up. Coal Mrs.	
153 Huntsville.	771 " 4 ft. coal.		107 Stanbury.	"	876
160 Clifton.	"	723	131 Marysville.	"	1037
167 Salisbury.	"	721	143 Roseberry.	"	977
178 Dalton.	"	637	Burlington Junc.	"	
185 Brunswick.	"	531	223 Council Bluffs, Ia.	"	989
192 Dewitt.	644 " [quarry.		Quincy, Missouri and Pacific Railroad.		
195 Miami.	" white s. s.		2 West Quincy.	20. Quaternary.	
202 Wakenda.	20. Quaternary.		11 Maywood.	13 a. Sub-Carb.	524
209 Carrollton. 687	14 b. Mid. Coal Mrs.		22 Tolona.	"	697
219 Norborne.	20. Quaternary.		32 La Belle.	"	741
228 Hardin.	"		47 Edina.	13 d. Overlaid by drift	
234 Lexington Junc.	14 b. Coal, middle ser.		54 Hurdland.	Deep drift.	723
239 Camden. 724	" 2 ft. coal.		70 Kirksville.	14 a. Lower Cl. Mrs. 975	
245 Orrick.	20. Quaternary.		Cooksville.	14 b.	995
254 Missouri City. 722	14 c. base of U. Cl. Ms.		Milan.	14 b. & 14 c.	840
265 N. Missouri Junc.	747 " "		137 Trenton.	"	
273 Harlem.	20. Quaternary.	746	Missouri, Iowa and Nebraska Railroad.		
275 Kansas City. 8	{ 14 c. Up. Cl. Mrs. 748		0 Alexandria.	20. Alluvium.	465
	{ Good Mollusca of		7 Wayland.	13 d. St. Louis l. s. 521	
	{ Up. Carb.		15 Kahoka.	14 a. Coal Mrs.	
St. Louis and Des Moines.			24 Luray.	"	
146 Moberly.	14 a. Lower Cl. Ms. 882		32 Arbela.	"	
153 Cairo.	"	860	40 Memphis.	"	
162 Emerson.	"	866	51 Downing.	"	
169 Macon.	"	900	61 Lancaster.	"	
180 Atlanta.	"	906	64 Glenwood.	"	
189 LaPlata.	"	940	70 Hamilton.	"	
196 Millard.	"	970	Missouri Pacific Railroad. 4		
203 Kirksville.	14 a. & b. "	975	0 St. Louis. 5	431 { 13 d. St. Louis l. s. &	
211 Sublett's.	"		7 Benton.	470 { 14 a. Coal Measures.	
218 Queen City.	14 a. "	1004	13 Kirkwood.	628 " "	
227 Glenwood.	"	990	34 Carondelet.	13 d. & 13 c. Keok.	
234 Coatesville.	"		19 Meramec.	420 13 b. Sub-Carbonifer's.	
(Continued in Iowa.)			26 Glencoe.	4 a. Trenton.	
St. Joseph Division.			30 Eureka.	"	
0 Lexington Junc.	14 b. Mid. Coal Mrs.		37 Pacific.	458 3 a. Calcif. & 4 a. Tren.	
9 Swanwick.	14 c. Base of up. Coal.		41 Gray's Sum't.	630 " 1st sandstone.	
19 Vibbard.	14 c. Up. Coal Mrs.		52 South Point.	510 " 2d Magn. l. s.	
25 Lawson.	"		54 Washington.	487 " "	
36 Lathrop.	"	948	67 Miller's L'd'g.	508 " "	
44 Plattsburg.	"	948	75 Berger.	518 " "	
53 Gower.	"	935	81 Hermann.	511 " "	
62 Agency Ford.	"		88 Gasconade.	488 " "	
73 St. Joseph.	"	827	92 Morrison.	522 " "	
Columbia Branch.			cap. with s. s.		
0 Centralia. 879	14 a. Lower Coal Mrs.				
22 Columbia.	14 a. and 13 b. & c.				

Ms.	Missouri Pacific Railroad—Cont.	Alt.	Ms.	Missouri Pacific Railroad.	Alt.
Lexington and Southern Branch—Continued.			Lexington and Southern Branch—Continued.		
100	Chamois. 531	"	54	Bedford.	14 a. Lower Coal Mrs.
105	St. Aubert. 527	"	56	Arthur.	" 710
125	Jefferson City. 624	"	69	Nevada.	" 870
140	Centretown. 856	lead " 2d sandstone.	82	Sheldon.	"
150	California. 856	" " 2d Magnes'n.	93	Lamar.	" coal and s. s.
		" " On hills some-	99	Carleton.	"
162	Tipton. 911	lead " times find 13 b.	105	Jasper.	13 c. Keokuk.
175	Otterville. 819	" " Bur'n l.s. & 3 a.	110	Cary.	"
188	Sedalia. 887	13 a. & b. Burlington l.s.	116	Carthage.	" Lime quar. 1269
195	Dresden.	" " Potter clay	119	Edwin.	" Zinc and lead.
200	Lamonte. 846	{ & 13 a. & 14 a.	126	Webb City.	" " "
208	Knobnoster.	14 a. Lower Coal Mrs.	133	Joplin.	" " 1018
218	Warrensburg. 697	" iron ore & coal Ms.	Warsaw Section.		
230	Holden. 750	" fine s. s. quarries.	0	Sedalia.	{ 13 a. Kinderhook 907
237	Kingsville. 894	14 b. Coal Mrs.			{ 13 b. Burlington.
248	Pleasant Hill.	14 b. & c. U. Coal Mrs.	20	Cole Camp.	3 a. Calcif., lead mines.
259	Lee's Summit.	" 826	42	Warsaw.	" on Osage River.
272	Independence.	" 1026	Creve Cœur Lake Branch.		
282	Kansas City.	" 998	0	Laclede.	13 d. St. Louis. 766
		" 781	12	Creve Cœur.	Lower Carb.
Lexington Branch.			St. Louis, Iron Mountain and Southern Division. 6		
0	Sedalia. 889	13 a. Sub-Carbonifer s.	0	St. Louis.	13 d. St. Louis l. s. 411
4	Georgetown.	13 a., b. & c. "	10	Jefferson Bar'ks.	13 d. Warsaw l. s. 418
22	Sweet Spgs. 647	13 b. Upper Sub-Carb.	13	Cliff Cave.	13 c. Keokuk l. s.
38	Aullville. 706	14 b. Coal Mrs.	21	Kimmswick. 415	13 b. Burl. l. s., lime.
55	Lexington. 786	2 ft. coal. " coal mines	24	Sulphur Springs.	" 411
63	Wellington.	14 b. "	26	Pevely.	4 a. Trenton. 441
75	Buckner.	" "	29	Horine. 7	{ 3 a. Calc., Sandy lead
87	Independence.	14 c. Up. Coal Mrs. 995			{ mine 6 miles north.
97	Kansas City.	" 748	35	Hematite.	3 a. Calciferous. 475
Versailles and Boonville Branches.			39	Victoria.	"
0	Versailles.	{ 3 a. 3d. Magn. l.s. 911	43	De Soto. 497	{ " Valle lead ms.
		{ lead ms. near, beau-			{ 10 miles so., Frumet
19	Tipton.	tiful cave 12 mi. so.			{ lead ms. 10 miles no.
33	Palestine.	13 b. Sub-Carb. on 3 a.			{ Good building stone.
44	Boonville.	13 a. Sub-Carb.	51	Blackwell.	3 a. Calciferous. 592
		13 c. " 607	57	Cadet.	" lead mine. 805
Lebanon Branch.			61	Mineral Pt. 868	" many lead ms.
0	Jefferson City. 418	3 a. Calcif. 2d Magn. l.s.	65	Potosi	" " "
11	Moreau.	" " 760	66	Hopewell.	" " " 985
19	Russellville.	" " "	70	Irondale. 796	" " "
28	Olean.	" Lead mines near	75	Bismarck.	" 1024
33	Eldon.	" " "	83	Loughborough.	2 b. Potsd. & 1 b. Hur.
37	Aurora Sp's. 1357	3 a. Calcif. 3d Magn. l.s.	87	De Lassus. 859	" [quarry.
40	Cooper.	" " "	95	Knob Lick. 926	" & granite
45	Bagnell.	" Osage River.			" lead, nickel,
Lexington and Southern Branch.			102	Mine La Motte. 847	{ cobalt, manganese,
0	Pleasant Hill.	14 c. U. Cl. Mrs. 826			{ copper, iron and
10	Harrisonville.	" " "			{ porphyry.
23	Archie.	{ 14 c. Upper & 14 b.	105	Frederick't'n. 721	2 b. Potsd. & 1 b. Hur.
		{ Mid. Coal Mrs.			{ 2 b., 1 b. & 3 a. Calc.
29	Adrian.	14 b. Mid. Coal Mrs.	112	Cornwall.	" Iron and granite.
38	Butler.	" 814	118	Marquand.	3 a. Calcif's, iron. 579
50	Rich Hill. 784	{ 14 a. L. C. Mrs., coal	125	Bessville. 531	" " "
		{ mines, beds 3 to 5 ft.	134	Lutesville.	" Lime. 853

3. Loess is well developed at Kansas City.

Chicago, Rock Island and Pacific R. R.			St. Louis and San Francisco, formerly At-		
Ms.	South-Western Division—Continued.	Alt.	Ms.	Atlantic and Pacific, Railroad. ¹¹	Alt.
86	Jamesport.	14 c. Upper Coal Mrs.	0	St. Louis.	481
102	Trenton.	"	37	Pacific.	488
127	Princeton.	"	44	Calvey.	759
143	Lineville.	" Middle	49	Moselle.	983
156	Allerton.	" series in	53	St. Clair.	759
169	Seymour.	" valleys.	66	Stanton.	867
Chicago and Alton Railroad.			78	Bourbon.	941
Chicago, Kansas City and Denver Line.			91	Cuba.	1010
275	Louisiana.	460 13 a. & b. & 10 c. & 4 c.	104	St. James.	1117
282	Watson.	904 " Hud. Riv.	114	Rolla.	1201
296	Bowling Green.	{ good building stone.	124	Ozark.	
298	Curryville.	13 c. Sub-Carbonif's.	138	Dixon.	1146
302	Vandalia.	"	144	Hancock.	1109
311	Ladonia.	14 a. Low. Coal Mrs.	150	Crocker.	1133
320	Littleby.	"	163	Richland.	1143
325	Mexico.	14 a. Low. Cl. Mrs. 798	171	Stoutland.	1166
339	Centralia.	" 379	178	Sleeper.	1209
361	Higbee.	377 " coal mines	186	Lebanon.	1269
381	Glasgow.	{ and 18 c. Keokuk.	217	Marshfield.	1498
393	Slater.	14 a. Low. Coal Mrs.	241	Springfield.	1860
404	Marshall.	{ 18 c. Keokuk 878	266	Logan's.	
415	Mt. Leonard.	{ and 18 c. Chester.	278	Verona.	1363
434	Higginsville.	14 a. Low. Cl. Mrs. 647	291	Peirce City.	1225
448	Odessa.	14 b. Mid. Coal Mrs.	306	Granby C'y.	1030
469	Oak Grove.	"	314	Neosho.	
478	Independence.	14 c. Up. Cl. Mrs. 995	325	Dayton.	947
489	Kansas City.	" 748	330	Seneca.	851
South Branch.			Arkansas Division.		
0	Chicago.		0	Peirce City.	{ 18 c. Keo. group. 1176
325	Mexico.	14 b. Mid. Cl. Mrs. 798	4	Plymouth.	" good lime qrs. 1326
345	Callaway.	"	29	Washburn.	"
350	Fulton.	14 a., 18 b. & 10 c. 848	35	Seligman.	" 1525
357	Carrington.	"	White River Branch.		
364	New Bloomfield.	"	0	Springfield.	1352
370	Hibernia.	10 c. and 3 a. 860	20	Ozark.	{ 13 a. Kinderhook, &
376	Jefferson City.	3 a. Calciferous. 418	35	Chadwick.	13 a. Kinderhook.

6. Down the St. Louis & Iron Mountain R. R. we have St. Louis limestone then Warsaw limestone, Keokuk limestone, and Burlington limestone within 20 miles. Crossing the Merrimac River, we find the last for a while, then the Receptaculite, Trenton and Black River limestone, 1st Magnesian limestone, and at Horine Station the Saccharoidal sandstone, very soft, used for glass-making, and is very white and pure. Afterwards we have 2d Magnesian limestone. Crossing Big River, the 3d Magnesian limestone near Iron Mountain. De Lassus, Mine la Motte, Fredericktown, Pilot Knob, Des Arc and Annapolis are porphyry hills of Huronian age, and the adjacent limestones and lower sandstones and conglomerates are probably Potsdam. At Mine la Motte and Fredericktown are certainly Potsdam fossils, but the absolute line (if any) has not been determined between the Potsdam and Calciferous beds. Near Iron Mountain, Knob Lick and Cornwall are superior granite quarries, which may be of age of Laurentian.

7. Four miles southeast is Crystal City on the Mississippi River, where glass is made. The Saccharoidal or St. Peter's sandstone is here forty or fifty feet thick, and over one hundred feet thick in Warren County. It is very valuable for glass-making.

8. Iron Mountain is 228 feet high, and its base covers 500 acres.

9. Pilot Knob is a conical hill, nearly circular, 581 feet high, with a north and south diameter of about one mile at its base, which covers 360 acres. Elevation 1,500 feet above sea.

10. Sheppard Mountain magnetic iron ore.

Ms. St. Louis & San Francisco R. R.— <i>Con. Alt.</i>			Kansas City, St. Jos. & Council Bluffs R. R.		
Ms.		Alt.	Ms.		Alt.
0	Springfield.	18 c. Keokuk. 1860	0	Mound City.	Quaternary. 861
21	Buckley.	"	11	Maitland.	14 c. Up. Coal. Mrs.
24	Graydon.	L. Carb. probably 18 b.	17	Skidmore.	"
39	Bolivar.	"	28	Quitman.	"
Joplin Branch.			29	Burlington Junc.	{ " Coal and 526 highest Upper Car- bonif's rocks in Mo.
0	Oronogo.	18 c. Keokuk mines.	Tarkio Valley Branch.		
4	Webb City.	" Handsome crys- tals of Blende, Calcite & Galena Zinc mines.	0	Corning.	Quaternary. 876
10	Joplin. 1018	18 c. Rich in lead & zinc	Fairfax.	" on 14 c. U. C. M.	
20	Galena.	"	Tarkio.	"	
Kansas Division.			28	Northborough.	"
0	Peirce City.	18 c. Keok. lime. 1225	Chicago, Burlington & Kansas City R. R.		
27	Carthage.	" Lime kilns.	Burlington & South-Western R. R.		
36	Oronogo.	" Zinc & lead.	0	Laclede.	14 b. Mid. Coal Ms. 787
44	Smithfield.	"	7	Linneus.	Iron. " Clays. 425
(Continued in Kansas.)			20	Browning.	" " 760
Girard Branch.			32	Milan.	14 c. Upper Carb. 840
0	Opolis.	18 c. Keok.	37	Boynton.	14 b. Mid. Coal Ms. 879
20	Joplin.	" Lead & zinc. 1018	45	Pollock.	" " 943
Kansas City, St. Joseph and Council Bluffs			58	Unionville.	14 a. Low. Cl. Ms. 1063
Ms.	Railroad.	Alt.	181	Burlington.	505
0	Kansas City. 748	{ 14 Upper Carbon. Good fossil mollusca	(Continued in Iowa.)		
10	Parkville. 753	14 c. Upper Carbon.	St. Louis, Keokuk & North-Western R. R.		
17	Waldron.	" 764	0	Keokuk.	18 c. Keokuk l. s. 465
25	E. Leavenworth.	" 773	5	Alexandria.	" 465
34	Weston.	" 773	22	Canton.	"
54	Winthrop.	" 801	28	La Grange.	20. Quaternary.
55	Rushville.	" 798	40	Quincy.	18 b. & c. Keok. ls. 488
66	Lake Station.	20. Quaternary. 826	53	Helton.	"
70	St. Joseph.	14 c. Upper Carbon. 824	59	Hannibal.	18 b. Sub-Carb. 469
80	Amazonia.	" fusulina abounds.	65	Saverton.	18 a. & b. " & 4 c. Cinn.
99	Forest City.	" " & mollusca.	74	Ashburn.	4 c. Hudson River.
109	Bigelow.	20. Quaternary. 861	84	Louisiana. 460	{ 4 c., 10 c. and 18 a. & b. Sulphur Sp'gs.
116	Craig. 871	" over 14 c.	94	Clarksville.	{ 18 a. Kinderhook. 18 b. Burlington & 10 Devonian.
122	Corning.	" 876	100	Kissenger.	18 a. and 18 b.
135	Phelps.	" 898	110	Elsberry.	{ 10 Dev'n, 4 a. Tren. and 4 b. Galena.
149	Hamburg.	" & 14 c. U. C.	Winfield.	18 d. St. L. Fault near.	
200	Council Bluffs.	899	Monroe.	18 c. Keokuk. 728	
(Continued in Iowa.)			188	St. Peters.	20. Quaternary.
Hopkins Branch.			St. Louis, Salem & Little Rock Railroad.		
70	St. Joseph.	14 c. Up. Carbon. 824	0	Cuba.	3 a. Calcif. 1010
79	Amazonia.	" Fusulina. 883	9	Steelville.	"
85	Savannah. 1100	Good " fossil molusca	24	Cook's.	"
91	Rosendale.	" 795	40	Salem. 1183	"
101	Barnard.	" 943	46	Orchard Bank.	"
108	Bridgewater.	"			Lead & iron
115	Maryville.	" 1037			
123	Pickering.	" 1028			
181	Hopkins.	" 1048			

11. On St. Louis & San Francisco R. R., going southwest, after leaving Pacific (or Franklin) the 2d Magnesian limestone gradually rises, showing some 2d sandstone, and through Crawford, Phelps, and Pulaski counties the latter is the highest rock, resting on 3d Magnesian limestone, the latter well exposed along the Gasconade River. Crossing it, we are upon the highest lands in Missouri. Descending towards Springfield, we find the Lower members of the Sub-Carboniferous

Kansas City, Fort Scott & Gulf Railroad.			Ms. Cape Girardeau Southwestern R. R. Alt		
Ms. Kansas City, Sp'gfield & Memphis Line. Alt.					
0 Fort Scott, Kan.	{ 14 b. Mid. Coal Mrs. Coal near.		0 Cape Girardeau.	{ 4 a. Trenton. 555 and 4 b. Galena.	
15 Arcadia.	{ 14 a. Low. Coal Mrs. Coal mines.		15 Delta.	{ 20. Quaternary with heavy timber	
88 Lamar.	" coal and sandst.		Lakeville.	" "	551
50 Golden City.	18 c. Keokuk.		40 Idlewild.	" "	
65 Greenfield.	" lead near.		52 Wappapello.	" "	
83 Ash Grove.	" lead and lime.		St. Louis, Hannibal & Keokuk Railroad.		
101 Springfield.	" 1852		St. Louis.		450
186 Seymour.	" 1850		0 Gilmore Springs.	18 c. Keok. & L. Carb.	
143 Cedar Gap.	{ Highest land in Mo. 8 a. Caloiferous. 1700		18 Moscow Mills.	" Archimedes fos.	
198 Willow Springs.	" 1270		18 Troy.	18 c. Keokuk.	
214 West Plains.	" 950		30 Silex.	18 a. and 18 b.	
Augusta.	" 3d Magn. l. 780		45 Edgewood.	"	
242 Mammoth S'pg.	" Big spring.		53 Bowling Green.	18 b. & Up. Silurian.	
Spring City.			60 McCunes.	4 a. Trenton group.	
Pleasant Hill & De Soto R. R.			67 Frankfort.	"	
0 Pleasant Hill.	14 c. Upper Coal Mrs.		Jones.	{ 8 a. 1st Magnes. l. s. & Saccharoidal s. s.	
12 Raymore.	"		76 New London.	4 a. Tren. & Black Riv.	
17 Belton.	"		86 Hannibal.	13 a. & b. good lime qrs.	459
25 Stanley.	(See Kansas.)		Chicago, Burlington & Quincy Railroad.		
(Continued in Arkansas.)			Des Moines Charlton & St. Joseph Branch.		
Rich Hill Branch.			0 St. Joseph.	14 c. Up. Coal Ms. 753	
0 Miami.	14 a. Lower Coal Mrs.		49 Albany.	"	
13 Rich Hill.	" coal mines. 764		65 Bethany.	"	
19 Carbon Centre.	" " 772		90 Andover.	"	
St. Louis & Emporia Railway.			98 Bethany Jc., Ia.		
0 Blue Mound.	14 a. Lower Coal Mrs.		Grant City.	14 c. Upper Coal Mrs.	
20 Pleasanton.	" & 14 b. Mid. Cl. "		Clarinda Jc., Ia.	"	
Kansas City, Clinton & Springfield R. R.			Burlington Jc.	"	
0 Kansas City.	14 c. Upper Coal Mrs.		Quincy Hannibal & Louisiana Branch.		
21 Olathe, Kan.	" 1080		0 Quincy.	18 b. & c. Keok. l. s. 458	
38 Belton, Mo.	"		7 Marble Head.	20. Quaternary.	
48 Raymore.	"		18 Fall Creek.	"	
56 Harrisonville	"		19 Hannibal.	18 b. Sub-Carb. 459	
62 Dougherty.	14 b. Middle Coal Mrs.		28 Kinderhook, Ill.	{ 10 c. bl. sl. 18 a. Kin- derh. & 18 b. Burl.	
95 Clinton.	14 a. Up. Coal Mrs. 507		44 Louisiana.	4 c. 10 c. & 18 a. & b. 450	
119 Osceola.	8 a. Calc. & 18 a. & 18 b.		Texas & St. Louis Railroad.		
189 Humansville.	18 b. Burlington.		Missouri & Arkansas Division.		
175 Ashgrove.	18 c. Keokuk.		0 Birds Point.	20. Quat., Swamp dist.	
Kansas City and Southern.			87 Paw Paw Junc.	" } Low,	
0 Osceola.	14 a. & 18 b.		48 New Madrid.	" } swampy,	
13 Otter Creek.	14 a. Lower Coal Mrs.		58 Malden.	" } Heavy 297	
16 Browning	18 b. Burlington.		70 St. Francis, Ark.	" } timber. 288	
17 Grand River.	14 a. Lower Coal Mrs.		St. Louis, Creve Coeur & St. Charles R. R.		
21 Vickers.	14 a. Good fossil plants		0 St. Louis.	18 d. St. Louis.	
26 Clinton. 507	14 a. & 14 b.		5 Rinkleville.	14 a. Lower Coal Mrs.	
Urich.	14 b. Mid. Coal Mrs.		16 Florissant.	20 on 14 a. Rich Valley	
Index.	"				
67 East Lynne.	"				

limestone resting on the 2d Magnesian limestone or Caloiferous. In southern parts of Lawrence County we find a coarse ferruginous sandstone, probably equivalent to Millstone Grit, but more probably a member of the Chester group, resting on Lower Carboniferous limestone. Throughout Newton and Jasper, the Sub-Carboniferous limestone, with much chert is of great development, and is galeniferous. The celebrated lead mines of Joplin and Granby occur in this.

Kansas.¹

LIST OF GEOLOGICAL FORMATIONS IN KANSAS.

20. Quarternary.	20 d. Alluvium. 20 c. Loess. 20 b. Modified Drift. 20 a. Glacial Drift.	Carbonifer's. 16-18 Mesozoic	18 Cretaceous.	18 c. Niobrara, including the "Colorado" above. 18 b. Ft. Benton. 18 a. Dakota.
			16-17 Jura-Trias, or Red Beds.	
19. Tertiary.	19 c. Pliocene, including deposits of Volcanic ash—possibly of Quarternary age.		Upper Carboniferous.	15. Permian or Permian-Carboniferous. 14 c. Upp. Cl. Meas. 14 b. Low. Cl. Meas.
	19 c. Miocene.		Lower Carboniferous.	13c. Keokuk, limest. & chert, bearing of Lead and Zinc.

Union Pacific Railway. Kansas Division.			Union Pacific Railway. Kansas Division.		
Ms.		Alt.	Ms.		Alt.
0	Kansas City. (Union Depot.)	{ 14 c. Upper Coal Measures.			
1	Kansas City, Kansas.		78	Menoken.	14c. Upp. Coal Mrcs. ⁹⁰³
2	Armstrong.	748	78	Silver Lake.	" 915
9	Muncie.	748		Kingsville.	" 920
13	Edwardsville.	755	83	Rossville.	" 923
17	Bonner Springs.	767	91	St. Marys.	" 955
	Loring.	767	97	Bellvue.	" 965
23	Lenape.	788	104	Wamego.	" 1000
28	Linwood.	789	111	St. George.	" 1000
32	Fall Leaf.	789	119	Manhattan. ⁷	" 1000
39	Lawrence.	781		Eureka Lake.	15. Permo-Carbonif.
45	Buck Creek.	789	130	Odgersburg.	" 1060
48	Williamstown.	809	135	Ft. Riley.	" 1070
51	Perryville.	822	139	Junction City. ⁸	" 1082
53	Medina.	846	146	Kansas Falls.	" 1106
55	Newman.	851	152	Chapman.	" 1114
61	Grantville.	852	158	Detroit.	" 1135
67	Topeka. ³	853	163	Abilene.	" 1155
		861	172	Solomon. ⁹	" & 18 a. Dak. ¹¹⁷⁵
		877	180	New Cambria.	" 1189
		880	186	Salina.	" 1225

1. By Mr. Orestes St. John of Topeka, Kansas.

2. *Leavenworth.* In the vicinity of Leavenworth and at the State Penitentiary at Lansing, a 21-inch seam of coal is mined by means of shafts at a depth of between 700 and 800 feet. The limestones crossing the bluffs that hem the Missouri are richly stored with characteristic upper coal measure fossils. The Loess heavily covers the bluffs, and in the bed of the Missouri Valley the glacial drift occurs beneath the alluvial deposits. Deposits of modified drift or stratified gravels locally intervene between the Loess and the basis rocks of the region.

3. *Topeka.* The Osage coal crops in the western suburbs of the city, where it is mined to limited extent. An experimental diamond drill boring, authorized by the local government, has penetrated the coal measure series to the depth of between 1,600 and 1,700 feet at this writing, encountering several thin deposits of coal.

Union Pacific Railway. Kansas Division.—Con.			Union Pacific Railway. Leavenworth, Topeka & South Western Line.		
Ma.		Alt.	Ma.		Alt.
194	Bavaria. ¹⁰	18 a. Dakota. 1371	0	Leavenworth. ³	{ 14 c. Upper Coal Measures. 765
201	Brookville.	" 1340	9	Bolings.	" 908
	Arcola.	" 1423	16	Springdale.	" 1032
	Terra Cotta.	" 1470	21	McLouth.	" 1157
211	Carneiro. ⁴	" 1570		McIntosh.	" 1135
	Mt Zion.		28	Oskaloosa.	" 939
218	Kanopolis.	18 b. Benton. 1530		Osawkee.	" 876
228	Ellsworth.	" 1533	45	Meriden.	" 964
	Black Wolf.	" 1565	56	Topeka. ⁵	" 834
	Cow Creek.	"	Blue Valley Line.		
239	Wilson.	" 1634			
	Dorrance.	" 1730	0	Manhattan. ⁷	{ 14 c. Upper Coal Measures, and 15. Permo-Carbon. 1000
253	Bunker Hill.	" 1864		Stockdale.	"
	Homer.	" 1874	17	Garrison Cross'g.	" 1031
263	Russell.	" 1832		Winkl'r's Mills St.	"
	Gorham.	" 1913	22	Randolph.	" 1033
	Walker.	" 1944		Cleburne.	"
279	Victoria.	" 1928		Florena.	"
	Toulon.	"	39	Irving.	" 1127
289	Hays.	"Up. l. s. 1991	43	Blue Rapids.	" 1141
	Hogback.	"		Schroyer.	"
303	Ellis.	" 2117	56	Marysville.	" 1179
318	Ogallah.	18 b. Niob. & 19. Tertiary 2367		Hull.	"
321	Wakeeney. ⁵	" " 2456	65	Oketo.	" 1200
	Colono.	19. Tertiary in uplands.	Solomon Valley Line.		
335	Collyer.	" 2556			
	Quinter.	"	0	Solomon. ⁹	{ 15. Permo-Carboniferous and 18 a. Dakota. 1173
350	Buffalo Park.	" 2755		Niles.	"
356	Grainfield.	" 2811	9	Verdi.	" 1202
365	Grinnell.	" 2904	15	Bennington.	" 1228
377	Oakley.	" 3042	21	Lindsay.	" 1242
385	Monument.	" 3131	23	Minneapolis.	" 1256
	Boaz.	"	29	Sumnerville.	" 1285
398	Winona.	" 3464	35	Delphos.	" 1310
406	Lisbon. ⁶	"& 18 c. Colora. 3140	42	Glasco.	" 1319
	McAllaster.	"	47	Brittsville.	" 1334
	Turkey Creek.	"	50	Asherville.	" 1346
420	Wallace.	" 3301	57	Beloit.	" 1353
429	Sharon Springs.	" 3450	Salina and Upper Solomon Line, or Lincoln and Colorado Branch.		
437	Monotony.	" 3774			
	Montero.	"	0	Salina.	{ 18 a. Dakota, and 15. Permo-Carboniferous. 1173
Leavenworth and Lawrence Branch.				Trenton.	"
				York.	"
0	Leavenworth. ³	14 c. Up. Cl. Mres. 765	12	Culver.	" 1265
5	Lansing.	" 781			
11	Fairmount.	" 955			
15	Hoge.	" 854			
18	Big Strainger.	" 834			
19	Moore.	" 915			
21	Tonganoxie.	" 851			
26	Reno.	" 835			
34	Lawrence.	" 822			

4 *Carneiro*. The Dakota sandstone weathered into picturesque monumental shapes.

5 *Wakeeney*. In the ravine cutting the upland slopes, the chalky limestones of the Niobrara outcrop, affording characteristic vertebrate and molluscan fossils. The manufacture of the chalk into whiting is here successfully engaged in. Copious springs of delicious water issue from the gravel deposit at the base of the Tertiary.

6 *Lisbon*. The Colorado shales appear in the valley sides and outlying buttes, capped by Tertiary conglomerate in places, containing beautifully dendritic marked chalcodony. The Colorado shales abound in selenite crystals, septaria concretions and fossils.

7 *Manhattan*. The light gray limestone in the bluffs, and which form a convenient lithological demarcation between the brown limestone of the upper coal measures and the Permo-carboniferous

Union Pacific Railway.			Union Pacific Railway.		
Ms.	Salina and Upper Solomon Line, or Lincoln and Colorado Branch.—Con.	Alt.	Ms.	Kansas Central Line.	Alt.
19	Tescot.	{ 18 a. Dakota and 15 Permo-Carb. 1297	0	Leavenworth. ²	{ 14 c. Upper Coal Measures. 765
24	Beverly.		7	Hund.	" 820
35	Lincoln.	1324	11	Pleasant Ridge.	" 1051
	Vesper.	1373	15	Easton.	" 983
	Sylvan.		20	Lee.	" 1028
56	Lucas.	1718	25	Winchester.	" 1138
66	Luray.			Boyle.	" 1165
72	Waldo.		36	Valley Falls.	" 911
	Ivamar.			Arrington.	"
88	Natoma.		46	Larkin.	" 938
	Codell.		51	Elk.	" 971
104	Plainville.		55	Holton.	" 1012
111	Zurich.		63	Circleville.	" 1096
	Palco.		70	Soldier.	" 1184
	Daman.		76	Havensville.	" 1165
130	Bogue.		79	Savannah.	" 1104
138	Hill City.		82	Onago.	" 1093
	Redford.		96	Blaine.	15. Permo-Carb. 1503
	Kalula.		110	Olsburg.	" 1427
	Carll.		117	Garrison.	" 1058
	Tasco.			Leonardville.	"
171	Hoxie.	19. Tertiary.	139	Green.	" 1287
	Gerona.	"	147	Clay Centre.	" (1283 1268)
	Zillah.	"		Idane.	"
	Verner.	"	166	Miltonvale.	18 a. Dakota? 1372
204	Colby.	"	St. Joseph & Grand Island R. R.		
225	Oakley.	3042	0	St. Joseph, Mo.	{ 14 c. Upper Coal Measures. 825
Salina and Southwestern Railway.			1	Elwood.	" 817
0	Salina.	{ 15. Permo-Carb. and 18 a. Dak. 1225	6	Wathena.	" 818
	Mentor.	" 1282	9	Blairs.	" 897
12	Assaria.	" 1300	14	Troy.	" 1093
16	Bridgeport.	" 1380	19	Norway.	" 1042
21	Lindsburg.	18 a. Dakota.	23	Ryans.	" 892
	Johnstown.	"	25	Severance.	" 903
	Hilton.	" 1490	29	Leona.	" 918
36	McPherson.		34	Robinson.	" 950
Junction City and Ft. Kearney Branch.			38	Mannville.	" 975
0	Junction City. ⁸	15. Permo-Carb. 1082	43	Hiawatha.	" 1095
8	Alida.	" 1109	50	Hamlin.	" 984
14	Milford.	" 1102	54	Morrill.	" 1098
19	Wakefield.	" 1152	61	Sabetha.	" 1305
28	Broughton.	" 1183	69	Oneida.	" 1219
33	Clay Centre.	" 1203	77	Seneca.	{ 15. Permo-Carbon- iferous. 1183
41	Morganville.	" 1238	84	Baileyville.	" 1296
49	Clifton.	18 a. Dakota. 1277	89	Axtel.	" 1368
50	Vining.	" 1277	99	Beattie.	" 1299
56	Clyde.	" 1299	105	Home.	" 1329
63	Lawrenceburg.	" 1329	113	Marysville.	" 1155
71	Concordia.	" 1366	118	Herkimer.	" 1238
63	Lawrenceburg.	" 1329	128	Hanover.	18 a. Dakota? 1225
65	Christie.	" 1341	137	Hollenberg.	" 1256
70	Talmo.	" 1365			
80	Belleville.	" 1551			

series, are extensively quarried for building purposes. Underlying the quarry ledges is a heavy stratum of soft buff earthy limestone, possessing the properties of an hydraulic limestone, and preparations for the manufacture of cement have been made on quite an extensive scale.

St. Louis and San Francisco Railway. Ms. Monett (Mo.) to Halstead and Ellsworth. Alt.			St. Louis and San Francisco Railway. Ms. Monett to Halstead and Ellsworth. Alt.		
0	Carthage, Mo.	{ Lower Carbon. Keokuk limest. 956 14 b. Lower Coal Measures. 886 " 913 " 889 " 875 " 861	225	Burrton.	15. Permo-Carb.
23	Crestline.		234	Buhler, or Hamburg.	" ?
31	Columbus.		238	Medora.	?
35	Welland, or Wilson.		252	Wherry.	?
37	Sherwin.		264	Lyons.	18 a. Dakota? 1691
39	Hallowell.		271	Clarence, or Pollard.	"
47	Oswego. ¹⁴	{ 14 c. Upper and 914 14 b. Low. Cl. Mres. 14 c. Upper Coal Measures.	275	Dacey.	"
	Stover.		281	Lorraine.	" ?
58	Altamont.	" 924	288	Phipps.	18 b. Benton. ?
64	Mound Valley.	" 889	295	Ellsworth.	" 1532
69	Big Hill.	" 886	Arkansas City and Anthony Line.		
74	Cherryvale.	" 853	0	Beaumont.	15. Permo-Carb. 1604
83	Brooks.	" 897	7	Burgess.	"
88	Neodesha. ¹⁵	" 816	13	Latham.	"
	Dun.	"	19	Wingate.	"
101	Fredonia.	" 975	23	Atlanta.	"
107	New Albany.	" 913	31	Wilmot.	"
113	Fall River.	" 940	34	Floral.	"
119	Greenwood.	" 1011	40	Younts.	"
125	Severy.	{ 15. Permo-Carbon- iferous? 1124	42	Winfield. ¹⁸	" 1112
134	Piedmont.	" 1216	50	Tresham.	"
140	Derry.	" 1470	57	Arkansas City.	" 1064
145	Beaumont. ¹⁶	" 1604		Cale.	"
152	Keighley.	" 1342	64	Geuda Springs.	"
160	Leon.	" 1349	69	Ashton.	"
165	Haverhill.	" 1340	73	Portland.	"
171	Augusta.	" 1246	79	South Haven.	" 1124
177	Lorena.	" 1356	81	Hunnewell Ju.	" 1102
181	Andover.	" 1370	84	Drury.	"
186	Manchester.	" 1402	86	Falls.	"
192	Wichita. ¹⁷	" 1318	91	Caldwell.	"
195	Davidson.	"	101	Blackstone.	"
197	Wichita Heights.	"	106	Bluff.	
201	Valley Centre.	" 1339		Blackburn.	
210	Bentley.	"		Anthony.	16 Triassic.
219	Paterson.	"	Wichita and Halstead.		
			0	Wichita. ¹⁷	15. Permo-Carb. 1316
			10	Valley Centre.	" 1355
			17	Sedgwick.	" 1385
			25	Halstead.	" 1402

8. *Junction City.* Extensive quarries in heavy ledges of light buff limestone, used in the construction of the east wing of the Capital at Topeka.

9. *Solomon.* Strong brine wells in gypsiferous shales of the Permo-carboniferous, from which salt has been manufactured quite extensively.

10. *Basaria.* The Dakota sandstone near this place affords numerous characteristic fossils. Near Brookville *Dicotyledonous* leaves abundant in the sandstone.

11. *Pittsburg.* Centre extensive coal mining interests and zinc smelting furnaces. The ores are brought from Galena and adjacent mining districts in Missouri, in the lower carboniferous rocks.

12. *Weir City.* Centre of coal mining district, zinc smelting establishments.

13. *Galena.* Extensive lead and zinc mines in lower carboniferous Keokuk formation.

14. *Oswego.* The Neosho river is excavated into the lower coal measures, the upper coal horizons of which appear at various localities in the vicinity. The plateau upon which the town is located, is formed by the basal limestones of the upper coal measures, including the horizon of the Ft. Scott coal, which is here a bituminous shale and the cement rock. Interesting localities for both upper and lower coal measures fossils.

15. *Neodesha.* Along the Verdigris and Elk rivers a heavy ledge of sandstone occurs, which belongs well up in the upper coal series, and affords remains of large trees peculiar to the coal measures period. Although the Verdigris has cut its bed more deeply, geologically it is more than a thousand feet above the Neosho at Oswego, or on the line of greatest depression between the *Ozark* region of S. W. Missouri and the first great highland belt traversing Central Kansas from near the south border to the Nebraska line on the north.

St. Louis and San Francisco Railway.			Missouri, Kansas and Texas Ry.		
Ma.	Girard Branch.	Alt.	Ma.	Neosho Valley Section.	Alt.
0	Carl Junction.	{ 18. L. Carb. and 14b. L. Coal Mres. 14 b. Lower Coal Measures.	0	Parsons.	{ 14 c. Upper Coal Measures.
12	Opolis.	" 928	5	Ladore.	" 909
18	Litchfield Jo.	" 928	11	Galesburg.	" 979
19	Pittsburgh. ¹¹	" 924	17	Urbana.	" 931
22	Lone Oak.	" 966	26	Chanute.	" 910
29	Girard.	{ Upper and Lower Coal Measures. 1002	35	Humboldt Stat'n, So. K.	" 952
Weir City Branch.			44	Piqua.	" 980
0	Pittsburgh.	{ 14 b. Low. Cl. Mres. 954	50	Neosho Falls.	" 980
10	Weir City. ¹²	" 924	56	Moody.	" 994
Joplin and Galena.			59	LeRoy.	" 1037
0	Joplin.	{ Lower Carbonif. 1028	64	Bristol.	" 1037
9	Galena. ¹³	{ 13 c. Keokuk " 892	67	Burlington.	" 1037
Missouri, Kansas and Texas Ry. In Kansas.			75	Rockeby.	" 1037
0	Nevada, Mo.	{ 14 b. Lower Coal Measures. 870	82	Hartford.	" 1122
21	Ft. Scott.	{ Low. and Upper Coal Measures. 802	88	Wyckoff.	" 1152
28	Ronald.	{ 14 c. Upper Coal Measures.	95	Emporia.	" 1152
34	Hiattville.	" 1003	104	Americus.	" 1152
41	Heppler.	" 1002	111	Dunlap.	" 1152
48	Walnut.	" 921	120	Council Grove.	{ 15. Permo-Car. boniferous.
56	Osage Mission.	" 890	127	Downing Station.	" 1237
62	South Mound.	" 922	182	Parkersville.	" 1476
69	Parsons.	" 902	137	White City.	" 1236
78	Labette.	" 864	144	Skiddy.	" 1236
83	Oswego.	{ 14 c. Upp. and 14 b. Low. Cl. Mres. 895	152	Wreford.	" 1032
93	Chetopa.	{ 14 b. Lower Cl. Measures. 832	157	Junction City.	" 1032
			Lawrence and Southwestern R. R.		
			0	Lawrence.	{ 14 c. U. Coal Mres. 822
			10	Clinton.	" 871
			18	Belvoir.	" 901
			19	Richland.	" 901
				Ridgeway.	" 1122
			27	Kinneys.	" 1072
			31	Carbon Hill.	" 1072
			32	Carbondale.	" 1072

16. *Beaumont*. Summit of the "Flint Hills," composed of a cherty member and the light buff limestones of the Permo-Carboniferous, forming a highland bench of the type of a monocline, presenting a somewhat abrupt eastern scarp and long gentle westerly slope. A conspicuous topographic feature at intervals across the central portion of the State to the Nebraska line.

17. *Wichita* lies within the area occupied by the heavy series of shaly deposits, to which the great saline and salt beds, occurring in central Kansas, belong. These deposits underlie the "red beds" presumably of Triassic age, and are in conformable sequence with the underlying porous limestones and shales of the so-called Permo-Carboniferous.

18. *Winfield*. Extensive quarries of even, thick, and thin-bedded limestone, affording fine building material and flagging in the vicinity.

19. *Scott City*. Basin receives considerable drainage from the west.

20. The line from La Crosse follows the water-shed south of the Smoky Hill, an elevated plain steadily increasing in altitude to nearly 4,000 feet on the west boundary of the State, and blanketed by Tertiary deposits. The Niobrara appears along the more deeply eroded drainage channels flowing to the Smoky Hill, the exposures affording characteristic fossils.

21. *Louisburg*. Natural gas wells, also near Somerset.

22. The highlands west of Mankato are blanketed by Tertiary deposits, the Cretaceous, Niobrara, appearing at intervals in the more deeply cut drainage channels. The latter deposits abound in characteristic fossils, vertebrates and mollusks.

23. *Paola*. Natural gas found in drilled wells in vicinity, in considerable volume.

24. *La Cygne*. Coal shaft, to workable vein in lower portion of Upper Coal measures.

25. *Pleasanton*. Coal shaft, same coal mined at La Cygne. On mine creek, S. E. of the town, the ores of lead and zinc occur in Upper Coal measures strata. Near the town a bituminous sandstone affords flagging layers.

26. *Ft. Scott*. Gas and mineral water developed in drilled wells. Associated with a thin coal which has been extensively worked by surface stripping in the vicinity and south to Arcadia and Mulberry, occurs an hydraulic limestone, which furnishes material for the manufacture of cement, which is extensively engaged in at Ft. Scott.

27. *Farlington*. In the vicinity, extensive quarries have been opened in a flagging sandstone.

Missouri Pacific Railway.			Missouri Pacific Railway.		
Ms. Omaha, St. Joseph & Kansas City Line. Alt.			Ms. Denver & Kansas City Line.—Con. Alt.		
0 Kansas City.	14 c. Up. Cl. Mres.	745	158 Helmick.	{ 15. Permo-Car-boniferous.	
3 Wyandotte.	"		163 Wilsey.	"	
Ramapo.	"		170 Delavan.	"	
10 Nearman.	"		177 Herington.	"	
13 Pomeroy.	"		185 Hope.	"	
15 Connors.	"		190 Swrayne.	"	
19 Ross.	"		194 Banner City.	"	
Lansing.	"		197 Carlos.	"	
26 Leavenworth. ²	"	765	205 Gypsum City.	"	
29 Ft. Leavenworth.	"		207 Chico.	"	
Wade.	"		221 Salina.	{ 15. Permo-Car-1235 and Dakota.	
Kickapoo City.	"		230 Smolan.	"	
37 Oak Mills.	"		237 Falun.	"	
38 Port Williams.	"		246 Marquette.	"	
Dalbey.	"	798	224 Hallville.	15. Permo-Carbonif.	
47 Atchison.	"		230 Bridgeport.	"	
55 Shannon.	"		235 Lindsborg.	"	
58 Lancaster.	"		Smoky Hill.	"	
63 Huron.	"	1161	246 Marquette.	{ 15. Permo-Carb. and Dakota.	
67 Pierce Junction.	"		254 Langley.	18 a. Dakota.	
68 Everest.	"		259 Crawford.	"	
75 Willis.	"		265 Geneseo.	"	
79 Baker.	"		272 Frederick.	"	
87 Hiawatha.	"	1094	278 Bushton.	"	
92 Pandona.	"		286 Claflin.	"	
96 Reserve.	"		299 Hoisington.	"	
Denver and Kansas City Line.			309 Great Bend.	"	
0 Kansas City.	14 c. Up. Cl. Mres.	745	308 Boyd.	18 a. Dakota.	
Martin City.	"		309 Olmutz.	" ?	
Stillwell.	"		316 Otis.	18 b. Benton.	
38 Bucyrus.	"		331 La Cross. ²⁰	"	
45 Wagstaff.	"		346 McCracken.	19. Tertiary.	
53 Paola.	"		349 Holbrook.	"	
60 Ossawatimie.	"		357 Brownell.	"	
65 Obrien.	"		368 Ransom.	"	
69 Rantoul.	"		381 Utica.	"	
73 Imes.	"		390 Pen-Dennis.	"	
80 Ottawa. { Maria s des	"	896	396 Shields.	"	
Pomona. { Cygne's Riv.	"		406 Healey.	"	
94 Lomax.	"		412 Manning.	"	
101 Vassar.	"		423 Scott City. ¹⁹	"	
104 Lyndon.	"		433 Modoc.	"	
112 Osage City.	"	1075	Halcyon.	"	
117 Rapp.	"		444 Coronado.	"	
121 Miller.	"		447 Leoti.	"	
128 Admire.	"		457 Tuell.	"	
132 Allen.	"		465 Whitelaw.	"	
137 Bushong.	"		471 Horace.	"	
143 Comiskey.	"		Reid.	"	
151 Council Grove.	{ 15. Permo-Car-1238 boniferous.				

28. *Cherokee*. Extensive mining operations carried on in the main coal of the Lower coal measures, to the south and east as far as Stilson and Weir City.

29. *Galena*. Centre of an important mining district. The ores of lead and zinc occurring abundantly, extensive works for the smelting of the former are located here, the zinc ore being shipped to furnaces located on the coal belt, chiefly to Pittsburgh and Weir City and Rich Hill.

30. *Pittsburgh*. Centre of extensive coal mining operations and zinc smelting establishments. The coal is sought by means of shafts, 40 to above 100 feet in depth; the coal is fairly good, coking

Missouri Pacific Railway.			Missouri Pacific Railway.		
Ms.	Central Branch Line.	Alt.	Ms.	Central Branch Line.—Con.	Alt.
0	Atchison.	14 c. Upper Coal Measures. 793	217	Portis.	18 c. Niobrara.
13	Farmington.			Harlan.	"
15	Monrovia.		227	Gaylord.	"
18	Effingham.		232	Cedarville.	"
25	Muscotah.		242	Kirwin.	"
31	Whiting.		253	Marvin.	"
37	Netawaka.			Big Bend.	"
42	Wetmore.		268	Logan.	"
49	Goffs.		278	Densmore.	"
55	Corning.		282	Edmond.	"
62	Centraillia.	15. Permo-Carboniferous. 1270	293	Lenora.	"
70	Vermillion.		Kansas City and Paola Line. #		
74	Vleits.		0	Holden, Mo.	14 c. Up. Coal Mres.
78	Frankfort.		22	Harrisonville.	"
81	Barrett.		41	Louisburg. ²¹	"
85	Bigelow.		46	Sommeraset.	"
91	Irving.		54	Paola.	854
95	Blue Rapids.		Kansas, Nebraska and Dakota Division.		
100	Waterville.		0	Topeka. ³	14 c. Up. Cl. Mre. ²²²
107	Barnes.		11	Tevis.	"
113	Greenleaf.	18 a. Dakota. 1402	15	Richland.	" 901
	Washington.	" 1316	21	Swissvale.	"
120	Linn.	"	26	Overbrook.	"
125	Palmer.	"	33	Michigan.	"
129	Day.	"	41	Quenemo.	"
134	Clifton.	" 1281	48	Rosemont.	"
140	Clyde.	" 1310	56	Waverly.	"
155	Concordia.	" 1366		Amiet.	"
160	Yuma.	"	66	Dickey.	"
167	Norway.	" ?	72	Glenlock.	"
174	Scandia.	18 b. Benton.	80	Garnett.	" 1056
	Sherdall.	"	88	Bush City.	"
183	Republic.	"	93	Selma.	"
190	Warwick.	"	101	Blue Mound.	"
160	Yuma.	18 a. Dakota.?	106	Yoro.	"
166	Jamestown.	" ?	111	Mapleton.	"
176	Randall.	18 b. Benton.		Harding.	"
183	Jewell City.	"	120	Devon.	"
191	Mankato.	"	125	Azua.	"
199	Burr Oak.	18 c. Niobrara.?	130	Ft. Scott.	14b.L&14c.U.C.M. 802
166	Jamestown.	18 a. Dakota. ?	Denver, Memphis and Atlantic Division.		
172	Scottsville.	18 b. Benton.		Pittsburgh. ¹¹	14 b. Lower Cl. Ms. 954
179	Danville.	"		Cherokee.	" 938
184	Beloit.	" 1383		Folsom.	"
189	Solomon Rapids.	"		Sherwood.	"
195	Glen Elder.	"		Faulkner.	"
192	Cawker City.	"	371	Chetopa.	" 832
198	Downs.	"		Bartlett.	14 c. Up. Coal Mres
	Osborne.	18 c. Niobrara.?		Elm City.	"
	Bloomington.	"	386	Edna.	"
232	Alton.	"		Valeda.	"
	Woodston.	"		Kings.	"
250	Stockton.	"	401	Coffeenville.	" 726
208	Downs.	"	407	Deering.	"

and averages about 40 inches in thickness. Several thinner overlying coals occur in this region with which are associated fossiliferous shales and limestone. The town is supplied with water from a drilled well—feet deep, which penetrates to Lower Silurian formations.

21. Weir City. Coal mines and zinc smelting furnaces.

Missouri Pacific Railway.		Missouri Pacific Railway.	
Denver, Memphis & Atlantic Div.—Con. Alt.		Ms. Winfield, Indep. & Kan. City Line.—Con. Alt.	
Lyro.	14 c. Upper Coal Mres.	110 Belle Grade.	14 c. Up.Cl. Mres.
Maney.	"	111 Le Roy.	" 994
Meru.	"	115 Moody.	"
Medan.	"	121 Vernon.	"
Mogers.	"	129 Yates Centre.	"
Vauneta.	"	Rose.	"
Medarvale.	"	142 Buffalo.	"
Moosier.	15. Permo-Carbon.	145 Roper.	"
Dexter.	"	148 Benedict.	"
Arkansas City & Dexter.		151 Guilford.	"
Winton.	15. Permo-Carbon.	158 Altoona.	"
Cameron City.	"	165 Neodesha.	"
Silverdale.	"	Sycamore.	"
Arkansas City.	" 1064	174 Larimer.	"
Dexter.	"	179 Independence.	" 794
Waton.	"	187 Winton.	"
Sisdale.	"	193 Deering.	"
Winfield.	" 1112	198 Coffeetown.	" 728
Cellogg.	"	Roper and Peru.	
Wxford.	"	146 Roper.	14 c. Up. Coal Mres.
Belle Plaine.	" 1209	Cordley.	"
Silverdale.	" 1280	Sexton.	"
Marson.	"	Dill.	"
Conway Springs.	"	Fredonia.	"
Wilton.	"	La Fontaine.	"
Forwich.	"	Costello.	"
Belmont.	"	Elk City.	"
Clameda.	"	Colfax.	"
Kingman.	"	Hale.	"
Manalosa.	"	Monett.	"
Mcott.	"	Peru.	"
Iuka and Olcott.		Ft. Scott, Wichita and Western Railway.	
Wreston or Silverton.	1853	0 Ft. Scott.	{ 14 b. Lower Coal Measures. 802
Warmi.		7 Marmaton.	{ 14 c. Upper Coal Measures. 7917
Iuka.		10 Redfield.	"
Mcott.		15 Uniontown.	"
Wuron.		22 Bronson.	"
Wcola.		28 Moran.	"
Wafford.		35 La Harpe.	" 955
Wedford.		41 Iola.	"
Wudson.		48 Piqua.	"
Weward.		60 Yates Centre.	"
Way.		68 Batesville.	"
Warned.	1993	73 Toronto.	"
Winfield, Independ'ce & Kan. City Line.		81 Neal.	"
Wansas City.	{ 14 c. Upper Coal Measures. 746	87 Tonovay.	" 1073
Wssawatomie.	"	94 Eureka.	"
Wuncan.	"	104 Reece.	"
Wane.	"	111 Summit.	{ 15. Permo-Carboniferous.
Wreeley.	"	114 Rosalia.	"
Wlecla.	"	120 Pontiac.	" 1222
Warnett.	" 1056	127 Eldorado.	"
Warch.	"	136 Towanda.	"
Wont Ida.	"	142 Benton.	"
Westphalia.	"		
Wiceville.	"		

Missouri Pacific Railway.			Chicago, Kansas & Nebraska R'y.		
Ms. Ft. Scott, Wichita & West'n R'y.—Con. Alt.			Ms. Southwest Line: St. Joseph to Liberal.—Con. Alt.		
147 Greenwich.	15. Permo-Carb.		122 McFarland.	14 c. Up. Cl. Mres.	1088
152 Tolerville.	"		126 Alma.	"	1071
158 Wichita.	"	1291	134 Volland.	"	1191
164 Oatville.	"		142 Alta Vista.	{ 15. Permo-Car-	1442
169 Bayneville.	"		148 Dwight.	boniferous.	
174 Clearwater.	"			"	1510
179 Millerton.	"		157 White City.	{ Up. Coal Meas-	
186 Conway Springs.	"			ures. (Permo-	1479
190 Ewell.	"			Carboniferous.)	
196 Argonia.	"		164 Latimer.	"	1421
203 Freeport.	{ 16. Triassic Red		171 Herington.	"	1335
214 Anthony.	Beds.		179 Ramona.	"	1446
221 Goss.	"		186 Tampa.	"	1438
224 Ruella.	"		192 Durham.	"	1388
231 Corwin.	"		198 Waldeck.	"	1375
236 Hazelton.	"		205 Canton.	"	1602
242 Kiowa.	"		211 Galva.	"	1366
			218 McPherson.	"	1508
0 Pleasanton.	{ 14 c. Upper Coal		224 Groveland.	"	1496
7 Mound City.	Measures.	860	229 Aiken.	"	1335
12 Critzer.	"		235 Medora.	"	1494
19 Blue Mound.	"		245 Hutchison.	"	1844
27 Kincaid.	"		256 Partridge.	"	1625
Lone Elm.	"		263 Arlington.	"?	1609
39 Colony.	"	1121	271 Langdon.	"?	1701
46 Northcott.	"		278 Turon.	"?	1786
54 LeRoy.	"	994	285 Preston.	?	1853
Crandall.	"		292 Natrona.	?	1890
70 Gridley.	"		298 Pratt.	Probably Triassic	1920
Dunaway.	"		307 Cullison.	"red beds," with	2053
78 Wilbur.	"		314 Wellsford.	remnants of Ter-	2135
84 Madison.	"	1068	319 Haviland.	tiary forming the	2172
			324 Brenham.	superficial depos-	2214
			329 Greensburg.	its.	2245
			339 Mullinville.		2349
			348 Bucklin.		2425
Chicago, Kansas and Nebraska Railway.			Dodge City Branch.		
Southwest Line: St. Joseph to Liberal.					
0 St. Joseph, Mo.	{ 14 c. Upper Coal		356 Ford.		2423
	Measures.	840	366 Wilroads.		
1 Elwood, Kansas.	{ 20 d. Valley Allu-		373 Dodge City.	19. Tertiary.	2494
	vium.	831			
5 Wathena.	"	833	355 Kingsdown.	"	2523
13 Troy.	{ 14 c. Upper Coal		363 Bloom.	"	2600
	Measures.	1112	370 Mineola.	"	2568
19 Bendena.	"	1124	381 Fowler.	"	2495
24 Dentonville.	"	1088	392 Meade.	"	2515
29 Purcell.	"	1171	398 Jasper.	"	2713
34 Pierce Junction.	"	1161	406 West Plains.	"	2776
41 Horton Junction.	"	1029	412 Kismet.	"	2789
49 Whiting.	"	1118	421 Arkalon.	"	2625
54 Straight Creek.	"	1007	435 Liberal.	"	2853
60 Holton.	"	1057			
69 Mayette.	"	1210		South Line.	
76 Hoyt.	"	1180	171 Herington.	15. Permo-Carb.	1338
82 Elmont.	"	960	178 Lost Springs.	"	1487
89 North Topeka.	"	892	183 Lincolnville.	"	1442
90 Topeka.	"	892	194 Marion.	"	1320
101 Valencia.	"	913	200 Aulne.	"	1414
105 Willard.	"	927	208 Peabody.	"	1876
110 Maple Hill.	"	972	216 Elbing.	"	1491
118 Paxico.	"	1008	223 Whitewater.	"	1306

Chicago, Kansas and Nebraska R'y.			Chicago, Kansas and Nebraska R'y.		
South Line.—Con.		Alt.	Ms.	Colorado Line. In Kansas.—Con.	Alt.
urley.	15. Permo-Carb.	1424	254 Smith Center.	See Note 22.	1810
echi.	"	1383	261 Athol.	"	1792
ichita.	"	1310	268 Kensington.	"	1779
ladys.	"	1285	273 Agra.	"	1852
ack.	"	1280	278 Dana.	"	1870
yba.	"	1242	284 Phillipsburg.	"	1945
iverdale.	"	1330	291 Stuttgart.	"	2010
ellington.	"	1208	298 Prairie View.	"	2182
erth.	"	1223	307 Alma.	"	2161
orbin.	"	1171	311 Calvert.	"	2203
aldwell.	"	1126			
Clay Centre Line.			318 Norton.	{ Tertiary, overlying Niobrara extends thence into Col.	
cFarland.	14 c. Up.Cl. Mres.	1035	327 South Oronoque.		
abaunsee.	"	1059	335 Clayton.	"	2342
andale.	"	1007	342 Jennings.	"	2424
anhattan.	"	1027	351 Dresden.	"	2498
eats.	15. Permo-Carb.	1139	360 Selden.	"	2737
iley.	"	1289	371 Rexford.	"	2844
ala.	"	1281	380 Gem.	"	2937
osevale.	"	1195	388 Colby.	"	3099
lay Centre.	"	1213	396 Levant.	"	3145
organville.	"	1248	406 Brewster.	"	3517
ifton.	18 a. Dakota.	1281	415 Edson.	"	3421
lyde.	"	1310	424 Goodland.	"	3578
genda.	"	1424	433 Ruleton.	"	3693
uba.	"	1603	441 Kanorado.	"	3794
elleville.	"	1522		"	3912
Salina Line.			Kansas City, Wyandotte and Northwestern Railway.		
erington.	{ 15. Permo-Car-	1338	0 Kansas City.	{ 14 c. Upper Coal	
oodbine.	boniferous.	1265	2 Wyandotte.	Measures.	748
nterprise.	"	1154	4 Quindaro.	"	766
ilene.	"	1160	6 Welborn.	"	850
olomon.	{ 18 a. Dakota	1181	8 Calorific.	"	936
ew Cambria.	& 15. Permo-Car.	1211	9 Vance.	"	1002
alina.	"	1234	11 Bethel.	"	1007
Colorado Line. (In Kansas.)			12 White Church.	"	1004
orton Junction.	{ 14 c. Upper Coal	1029	13 Horanif.	"	1015
owhattan.	Measures.	1220	15 Maywood.	"	969
airview.	"	1229	17 Roper.	"	909
abetha.	"	1315	19 Menager Jo.	"	942
erwick.	"	1373	22 Baschor.	"	830
irn, Neb.	"	1295	28 Edminster.	"	846
ahasha, Kan.	18 a. Dakota.	1618	31 Tonganoxie.	"	932
arka.	"	1593	36 Neely.	"	1166
unden.	"	1636	41 McLouth.	"	995
elleville.	"	1522	47 Oskaloosa.	"	1159
candia.	18 b. Benton.	1438	53 Dunavant.	"	921
ourtland.	"	1506	61 Valley Falls.	"	1003
ormosa.	"	1521	71 Denison.	"	1039
ontrose.	"	1664	75 Birmingham.	"	1004
ankato.	"	1794	81 Holton.	"	1097
tego.	See Note 22.	1798	89 Circleville.	"	1156
zbon.	"	1835	94 Karmour.	"	1200
ebanon.	"	1822	101 Goffs.	"	1174
ellaire.	"	1872	108 Kelly.	"	

Kansas City, Wyandotte and Northwestern Railway.— <i>Con.</i>			Alt.
117 Seneca.	15. Permo-Carb.	1121	
128 Axtel.	"	1309	
134 Mina.	"	1430	
139 Summerfield.	"	1490	
Leavenworth Branch.			
20 Usher.	14 c. Up. Cl. Mres.	966	
21 Wallula.	"	964	
26 Lansing.	"	788	
28 Soldier's Home.	"	844	
30 So. Leavenworth.	"	768	
31 Leavenworth. ²	"	786	
34 Ft. Leavenworth.	"	838	
Burlington and Missouri River R. R. (In Kansas.) Atchison and Nebraska R. R.			
0 Atchison.	793 14 c. Upp. Coal Mres.		
7 Doniphan.	"		
12 Brenner.	"		
16 Troy.	"	1113	
22 Fanning.	"		
24 Highland.	"		
30 Iowa Point.	"		
35 White Cloud.	"		
Nebraska Railway. Hasting, Republican and Oberlin.			
0 Republican, Neb.	1944		
10 Woodruff.	{ 18 c. Niobrara in the deeper valleys; 19. Tertiary in the uplands.	2161	
17 Long Island.			
27 Almena.			
31 Seth.	"	2203	
38 Norton.	"	2278	
47 Oronoque.	19. Tertiary.	2342	
57 Norcatur.	"		
68 Kanona.	"		
78 Oberlin.	"		
Orleans and St. Francis.			
0 Orleans, Neb.	19. Tertiary.		
62 Cedar Bluffs.	"		
69 Traer.	"		
76 Herndon.	"		
86 Ludell.	"		
91 Atwood.	"		
95 Blakeman.	"		
102 Beardsley.	"		
110 McDonald.	"		
118 Bird City.	"		
128 Wheeler.	"		
134 St. Francis.	"		
Lincoln, Wymore and Concordia.			
0 Odell, Neb.		1281	
7 Lanham.	18 a. Dakota.		
14 Hanover.	"		
23 Emmons.	"		
Burlington and Missouri River R. R. In Kansas. Ms. Lincoln, Wymore and Concordia.— <i>Con.</i> Alt.			
26 Washington.	18 a. Dakota.		
33 Morrow.	"		
40 Haddam.	"		
50 Cuba.	"	1608	
58 Wayne.	"		
64 Hollis.	"		
72 Concordia.	"	1366	
Kansas City, Ft. Scott and Memphis Railroad.			
0 Kansas City.	{ 14 c. Upper Coal Measures.	765	
4 Rosedale.	"	835	
8 Merriam.	"	930	
14 Lenexa.	"	1040	
21 Olathe.	"	1060	
26 Bonita.	"	1105	
29 Ocheltree.	"	1080	
30 Spring Hill.	"	1020	
36 Hillsdale.	"	900	
43 Paola. ²³	"	860	
48 Pendleton.	"	855	
54 Fontana.	"	920	
62 LaCygne. ²⁴	"	820	
68 Barnard.	"	800	
74 Pleasanton. ²⁵	"	850	
79 Miami.	"	910	
82 Prescott.	"	880	
86 Fulton.	"	805	
92 Hammond.	"	860	
99 Ft. Scott. ²⁶	Low. & Up. CL M.	802	
103 Southeastern Jc.	14 c. Upp. CL Mres.	930	
106 Clarksburg.	" & Low. "	890	
110 Garland.	14 b. Low. CL "	802	
116 Arcadia.	"	850	
Baxter and Joplin Line.			
99 Ft. Scott. ²⁶	{ Lower and Upper Coal Measures.	802	
103 Southeastern Jc.	{ 14 c. Upper Coal Measures.	930	
105 Godfrey.	"	962	
111 Pawnee.	"	921	
117 Farlington. ²⁷	"	933	
125 Girard.	"	990	
130 Beulah.	"	977	
136 Cherokee. ²⁸	{ 14 b. Lower Coal Measures.	922	
142 Stilson.	"	909	
148 Columbus.	"	905	
154 Neutral.	"	862	
160 Baxter.	{ L. Carboniferous. ²⁹ 13 c. Keokuk.	821	
163 Lowell Station.	"	823	
167 Galena. ²⁹	"	892	
175 Joplin, Mo	"		

Kansas City, Ft. Scott and Memphis Railroad.— <i>Con.</i>			Atchison, Topeka and Santa Fe R. R.		
Ms. Cherryvale Line, via Pittsburg & Parsons. Alt.			Ms.	Emporia Branch.	Alt.
116 Arcadia.	{ 14 b. Lower Coal Measures.	850	0 Kansas City.	{ 14 c. Upper Coal Measures.	748
118 Coalvale.	"	883	13 Holliday.	"	758
123 Mulberry.	"	930	57 Ottawa. North.	"	
130 Minden.	"	967	68 Pomona.	"	
132 Midway.	"	925	72 Quenemo.	"	
137 Pittsburg. ³⁰	"	932	80 Melvern.	"	
143 Weir City. ³¹	"	923	86 Olivet.	"	
146 Cherokee. ²⁸	"	933	94 Lebo.	"	
153 Monmouth.	"	900	102 Neosho Rapids.	"	
157 McCune. ³²	{ 14 c. Upper Coal Measures—base of.	910	112 Emporia Jc.	"	
161 Mathewson.	"	853	113 Emporia.	"	
164 Laneville.	"	870	Howard Branch.		
171 Parsons.	"	902	0 Emporia.	{ 14 c. Upper Coal Measures.	1132
180 Dennis.	"	925	11 Olpe.	"	1068
184 Mortimer.	"	895	20 Madison.	"	
190 Cherryvale.	"	836	24 Madison Jc.	"	
Atchison, Topeka and Santa Fe Railr'd. ³⁵			35 Hamilton.	"	
Atchison Branch.			40 Utopia.	"	
0 Atchison.	{ 14 c. Upper Coal Measures.	793	47 Eureka.	"	1073
6 Parnell.	"	1089	56 Climax.	"	1018
9 Hawthorne.	"		63 Severy.	"	1098
11 Cummings.	"	981	69 Fiat.	"	
17 Nortonville.	"	1158	76 Howard.	"	1006
20 Nichols.	"	1001	84 Moline.	"	1050
26 Valley Falls.	"	907	Manhattan, Alma and Burlingame R'y.		
35 Rock Creek.	"	1057	0 Burlingame.	{ 14 c. Upper Coal Measures.	1042
39 Meriden.	"	964	8 Harveyville.	"	
40 Meriden Jct.	"	943	18 Eskridge.	{ 15. Permo-Car-boniferous.	1403
43 Kilmer.	"		25 Halifax.	"	
49 North Topeka.	"	872	34 Alma.	{ 14 c. Upper Coal Measures.	1051
50 Topeka.	"	884	37 Fairfield.	"	1060
Leavenworth Extension.			42 Pavillion.	"	1098
0 Kansas City.	14 c. Up. Cl. Mres.	748	45 Wabaunsee.	"	1011
17 Wilder.	"	770	49 Zeandale.	"	
18 Bonner.	"		56 Manhattan.	"	1000
Jaggard.	"		Strong City and Ellinor Extensions.		
29 Fairmount.	"	955	Bazar.	{ 15. Permo-Carboniferous.	
34 Lansing.	"		Gladstone.	"	
36 Home.	"		Cottonwood Falls.	"	
39 Leavenworth.	"	765	0 Strong City.	"	1172
44 Miocene.	"		2 Evans.	"	
50 Lowement.	"				
56 Potter.	"				
62 Hawthorne.	"				
71 Atchison.	"	793			

32. *McCune*. Coal shaft, sunk to one of the upper workable coals, overlying the main coal of the Lower coal measures of the region.

33. Fine flagging and building sandstone along the Neosho to the northeast.

34. Almost every locality within the Upper coal measures area afford deposits charged with fossils peculiar to the epoch.

35. The Kansas chapter properly ends at the Colorado line on the Atchison, Topeka and Santa Fe, but for convenience, the branches of that road are given first, the main line following and continued through Colorado into New Mexico.

Atchison, Topeka and Santa Fe Railroad. Ms. Strong City & Ellinor Extensions.—Con. Alt.			Atchison, Topeka and Santa Fe R. R. Ms. Little River Extension.		
7 Rockland.	15. Permo-Carbon.		0 Little River.	15. Permo-Carb. ¹¹⁵	
11 Hilton.	"		6 Galt.	"	
17 Diamond Springs.	"		10 Geneseo.	18 a. Dakota.	
23 Burdick.	"		14 Thomas.	"	
29 Lost Springs.	"		21 Lorraine.	"	
41 Hope.	"		26 Holyrood.	"	
48 Navarre.	"		29 West line of Ellsworth County.	"	
56 Enterprise.	"	1135 U. P.			
62 Abilene.	"	1155			
71 Talmage.	"				
				Great Bend Extension.	
75 Manchester.	{ 15. Permo-Carb. or 18 a. Dakota.		0 Great Bend.	18 a. Dakota. ¹²⁴	
82 Longford.	"		8 Heizer.	"	
87 Oak Hill.	"		15 Albert.	"	
97 Miltonville.	"		24 Timken.	"	
106 Aurora.	"		32 Rush Centre.	? or Benton.	
117 Concordia.	"	1366 U. P.	39 Nekoma.	{ 18 a. Dakota ? or Benton.	
131 Hackley.	{ 18 a. Dakota, or 18 b. Benton.		45 Alexander.	"	
138 Courtland.	"		52 Bazine.	"	
145 Lovewell.	"		64 Ness City.	"	
151 Webber.	"		72 Laird.	"	
155 State Line.	"		80 Beeler.	"	
157 Superior, Neb.	"		87 Alamota.	" ?	
			95 Dighton.	19 Tertiary.	
0 Abilene.	{ 15. Permo-Carbon- iferous. 1155		103 Ellen.	"	
8 Solomon.	{ 15. Permo-Carbonif. & 18 a. Dakota. ¹¹⁷⁵		109 Grigsby.	"	
17 New Cambria.	"	1189	120 Scott City.	"	
22 Salina.	"	1225	129 Modoc.	"	
0 Manchester.	18 a. Dakota.		133 Halcyon.	"	
7 Vine Creek.	"		141 Coronado.	"	
16 Wells.	"		144 Leoti.	"	
26 Minneapolis.	"	1257	154 Crosby.	"	
30 Brewer.	"		159 West Line Wichita County.	"	
36 Ada.	"				
40 Milo.	"				
45 Barnard.	"				
				Larned Extension.	
	McPherson Branch.		0 Larned.	{ 18 a. Dakota, ¹²⁹ Tertiary ?	
0 Florence.	{ 15. Permo-Car- ¹²⁶⁰ boniferous		6 Sage.	"	
4 Owesler.	"		17 Rozel.	"	
10 Marion.	"	1299	24 Burdett.	" ? or Bento	
15 Canada.	"		30 Gray.	"	
20 Hillsboro.	"	1424	35 Hanston.	"	
26 Lehigh.	"	1520	46 Jetmore.	"	
34 Canton.	"	1582			
40 Galva.	?				
47 McPherson.	?	1488			
53 Conway.	"	1527			
60 Windom.	"				
66 Little River.	"	1572			
72 Mitchell.	"	1731			
78 Lyons.	"	1691			
86 Chase.	"	1708			
98 Ellinwood.	18 a. Dakota.	1780			
				Augusta Extension.	
			0 Augusta.	{ 15. Permo-Car- ¹²² boniferous.	
			12 Rose Hill.	"	
			21 Mulvane.	"	10
			29 Hukle.	"	12
			35 Clearwater.	"	
			42 Viola.	"	
			47 Anness.	"	
			54 Norwich.	"	
			67 Rago.	16. Triassic ?	
			71 Spivey.	"	
			78 Rochester.	"	
			86 Nashville.	"	

Atchison, Topeka & Santa Fe R. R.				Atchison, Topeka & Santa Fe R. R.			
Ms.	Augusta	Extension.—Con.	Alt.	Southern Kansas Division.			
				Lawrence and Burlington Branches.			
93	Isabel.	{ Tertiary uplands, Triassic in Valleys.		0	Lawrence.	{ 14 c. Upper Coal ⁸⁴⁹ Measures.	
100	Sawyer.	19. Tertiary.		6	Sibley.	"	817
108	Coats.	"		9	Vinland.	"	881
115	Springvale.	"		15	Baldwin.	"	1046
124	Belvidere.	18 a. Dakota. ?		20	Norwood.	"	938
135	Wilmore.	" or Tertiary.		26	North Ottawa.	"	
144	Coldwater.	19. Tertiary.		27	Ottawa. (Marais des Cygnes R.)	"	896
154	Protection.	16. Triassic.		0	Ottawa.	"	896
164	Sitka.	"		4	Burlington Jct.	"	
170	Ashland.	"		11	Homewood.	"	
178	Manning.	"		14	Ransomville.	"	
185	Englewood.	"		17	Williamsburg.	"	
Osage City Extension.				23	Agricola.	"	
0	Quenemo.	{ 14 c. Upper Coal Measures.		27	Waverly.	"	
5	Deavers.	"		33	Hall's Summit.	"	
11	Lyndon.	"	1075	38	Sharpe.	"	
20	Osage City.	"		46	Burlington.	"	1037
Wichita and Western and Kingman, Pratt and Western Railroad.				56	Gridley.	"	
				Southern Kansas Division.			
0	Wichita.	{ 15. Permo-Car. ¹²⁹¹ boniferous.		0	Kansas City.	{ 14 c. Upper Coal ⁷⁴⁸ Measures.	
3	College Green.	"		13	Holliday.	"	758
14	Goddard.	"		16	Zarah.	"	
20	Garden Plain.	"		22	Elizabeth.	"	
26	Cheney.	"		26	Olathe.	"	1030
34	Murdock.	"		35	Gardner.	"	
45	Kingman.	"		40	Edgerton.	"	962
56	Calista.			45	Wellsville.	"	1041
63	Ninnescah.			50	LeLoup.	"	949
69	Cairo.			57	North Ottawa.	"	
77	Saratoga.			58	Ottawa. (Marais des Cygnes R.)	"	896
80	Pratt.		1920	62	Burlington Jc.	"	
89	Cullison.		2053	67	Princeton.	"	966
96	Wellsford.		2135	74	Richmond.	"	1017
100	Haviland.		2172	78	Scipio.	"	
106	Brenham.		2214	83	Garnett.	"	1056
110	Greensburg.		2245	91	Welda.	"	1098
120	Mullinville.		2349	99	Colony.	"	1121
125	W. Li'e, Kiowa Co.			105	Carlyle.	"	984
Hutchison and Kinsley Line. (South of the Arkansas River.)				110	Iola.	"	955
0	Hutchison.	{ 15. Permo-Car. ¹⁵²⁴ boniferous.		118	Humboldt.	"	952
11	Partridge.	"		127	Chanute.	"	910
17	Abbyville.	"		128	Eastern Jct.	"	
23	Plevna.	"		133	Earlton.	"	960
28	Sylvia.	"		140	Thayer.	"	1445
39	Safford.	18 a. Dakota ?		148	Morehead.	"	900
48	St. John.	"		156	Cherryvale.	"	836
55	Dillwyn.	"		166	Independence.	"	794
60	Macksville.	"		172	Crane.	"	783
67	Belpre.			178	Elk-City.	"	
75	Lewis.			185	Oak Valley.	"	
84	Kinsley.		2162	190	Longton.	"	919
				196	Elk Falls.	"	
				203	Moline.	"	1050

Atchison, Topeka and Santa Fe R. R.			Atchison, Topeka and Santa Fe R. R.		
Ms.	Southern Kansas Division.	Alt.	Ms.	Southern Kansas Division.	Alt.
211 Grenola.	15. Permo-Carb.	1112	308 Attica.	16. Triassic.	
218 Grand Summit.	"	1248	315 Crisfield.	"	
226 Cambridge.	"		323 Hazelton.	"	
227 Torrance.	"	1380	330 Kiowa.	"	
231 Burden.	"	1242	Girard Branch.		
239 New Salem.	"	1112	0 Chanute.	{ 14 c. Upper Coal	910
247 Winfield.	"		1 Eastern Junct.	Measures.	
248 Winfield Junct.	"		10 Shaw.	"	
254 Kellogg.	"		15 Erie.	"	
257 Oxford.	"		25 Walnut.	"	921
263 Dalton.	"		33 Brazilton.	"	
269 Wellington.	"	1219	41 Girard.	{ 14 c. Upper	990
127 Chanute.	14 c. Up. Coal	Mrs. 910	50 Frontenac.	and 14 b. Lower	
128 Eastern Junct.	"		54 Pittsburgh.	Coal Measures.	
135 Vilas.	"		57 Chicopee.	Measures.	
144 Benedict.	"		Douglass Branch.		
146 Benedict Junct.	"		0 Florence.	{ 15. Permo-Car.	1260
165 Coyville.	"		11 Burns.	boniferous.	1488
163 Toronto.	"		23 DeGraff.	"	1382
170 Quincy.	"		30 Eldorado.	"	1312
176 Virgil.	"		38 White.	"	1312
182 Hilltop.	"		42 Augusta.	"	1192
187 Madison.	"		49 Gordon.	"	
146 Benedict Junct.	"		54 Douglass.	"	1192
152 Fredonia.	"		59 Rock.	"	
160 Buxton.	"		65 Akron.	"	1112
166 Upola.	"	919	74 S. Winfield.	"	
171 Longton.	"		Hackney Sta.	"	1064
269 Wellington.	15. Permo-Carb.	1219	81 Arkansas City.	"	
277 Rome.	"	1216	Arkansas City Branch.		
284 South Haven.	"	1124	0 Newton.	{ 15. Permo-Car.	1438
287 Hunnewell.	"	1102	9 Sedgwick Junct.	boniferous.	1369
Independence Extension.			10 Sedgwick.	"	1368
166 Independence.	{ 14 c. Upper Coal	794	18 Halstead.	"	1366
173 Bolton.	Measures.		10 Sedgwick.	"	1368
182 Havanna.	"		17 Valley Center.	"	1339
187 Niota.	"		22 North Wichita.	"	1394
191 Peru.	"		27 Wichita.	"	1391
199 Chautauqua.	"		32 Green.	"	
205 Elgin.	"		38 Derby.	"	1271
206 New Elgin.	"		43 Mulvane.	"	1095
214 Hewins.	"		53 Udall.	"	1273
220 Cedarvale.	"		58 Seeley.	"	1162
Pan Handle Extension.			66 S. Winfield.	"	1112
261 Wellington.	{ 15. Permo-Car.	1219	71 Hackney Sta.	"	
262 Wellington Junct.	boniferous.		78 Arkansas City.	"	1064
270 Mayfield.	"				
277 Milan.	"				
282 Argonia.	"				
284 Albion.	"				
289 Danville.	16. Triassic.				
297 Harper.	"				
303 Crystal.	"				
308 Attica.	"				
319 Sharon.	"				
329 Medicine Lodge.	"				

Atchison, Topeka and Santa Fe R. R. Southern Kansas Division.			Atchison, Topeka and Santa Fe Railroad.		
Ms.	Caldwell Branch.	Alt.	Ms.		Alt.
0 Mulvane.	{ 15. Permo-Car- ¹⁰⁵⁵ boniferous.		148 Strong City.	{ 14 c. 15. Per- ¹²⁷³ mo-Carbonifer.	
6 Belle Plaine	"	1309	152 Evans.	"	1193
11 Cicero	"	1306	154 Elmdale.	"	
17 Wellington.	"	1319	162 Clements.	"	1237
27 Perth.	"	1301	166 Cedar Grove.	"	1266
81 Corbin.	"		173 Florence.	"	1314
89 Caldwell.	"	1103	180 Horner's.	"	1349
			184 Peabody.	"	
			188 Braddock.	"	1537
			194 Walton.	"	1488
			201 Newton.	"	1386
			211 Halstead.	"	
			220 Burrton.	"	1491
			227 Kent.	"	1534
			234 Hutchison.	"	
			239 Bath.	"	1593
			245 Nickerson.	"	1633
			253 Sterling.	"	1675
			259 Alden.	"	1721
			265 Raymond.	18 a. Dakota.	
			269 Clarendon.	"	1760
			275 Ellinwood.	"	
			280 Dartmouth.	"	1841
			286 Great Bend.	"	1893
			293 Dundee.	"	1939
			299 Pawnee Rock.	"	1992
			308 Larned.	"	
			313 Hamburg.	"	2060
			319 Garfield.	"	2113
			325 Nettleton.	"	2143
			332 Kinsley.	19. Tertiary.	2261
			341 Offerle.	"	2469
			346 Bellefonte.	"	2449
			352 Spearville.	"	
			361 Wright.	"	2475
			368 Dodge City.	"	2535
			377 Howell.	"	2616
			387 Cimarron.	"	
			393 Ingalls.	"	
			400 Charlestown.	"	2750
			406 Pierceville.	"	
			412 Mansfield.	"	2827
			418 Garden City.	"	2925
			425 Sherlock.	"	2933
			433 Deerfield.	"	2939
			440 Lakin.	"	3047
			449 Hartland.	"	

36. The portion of the line in Colorado is by Mr. S. F. Emmons, (see Colorado chapter), and that from Trinidad to the end of the chapter, with the notes, was prepared by James Macfarlane, but from what authority compiled, his notes do not in all cases indicate.

J. R. M.

37. The road follows the valley bottom of the Arkansas river; underlying rocks are Cretaceous.

S. F. E.

38. Pueblo. Niobrara limestone in R. R. cut north of town. Casts of *Inoceramus*.

S. F. E.

39. *Trinidad*. Coal mines in Laramie. Sandstones capped by basalt.

S. F. E.

40. *Santa Fe*. New Mexico is a very mountainous country with a large valley in the middle, in which is located the At. Top. and Santa Fe Railroad. The valley is formed by the Rio del Norte, which follows a generally southern direction, at least 2,000 miles from the region of eternal snow to the almost tropical climate of the gulf; and only the lower end of it, about 700 miles from Laredo to the mouth, is navigable. The valley is generally about twenty miles wide, and bordered on the east and west by mountain chains six or eight thousand feet high, and north of Santa Fe ten or twelve

Atchison, Topeka and Santa Fe			Atchison, Topeka and Santa Fe		
Ms.	Railroad.	Alt.	Ms.	Railroad.	Alt.
458 Kendall.	18 b. Ft. Benton.		Maxwell.	18. Cretaceous.	6061
465 Mayline.	"		692 Dorsey.	"	5883
470 Syracuse.	"	3213	716 Springer.	"	5766
477 Medway.	"	3224	736 Levy.	"	6238
485 Cooledge.	" ?	3239	758 Shoemaker.	{ 18. Cretaceous No. 1.	6254
487 State Line. ³⁵	" ?		766 Watrous.	"	6396
Colorado. ³⁶			775 Onawa.	{ 18. Cretaceous.	6728
491 Holley's. ³⁷	{ 20. Quat. River bottom.		780 Azul.	"	6670
501 Granada.	"	3436	786 Las Vegas.	"	6281
515 Blackwell.	"	3573	792 Hot Springs.	"	6709
526 Prowers.	"		805 Bernal.	{ 14. Carboniferous.	6058
537 Caddoa.	"	5736	815 San Miguel.	"	6019
546 Hilton.	"	5877	837 Pecos.	"	
552 Las Animas.	"	5884	841 Glorieta.	"	7413
562 Robinson.	"	5977	846 Canoncito.	{ 18. Cretaceous No. 1.	6051
571 La Junta.	"	4044	849 Manzanares.	{ 14. Carboniferous.	6669
590 Catlin.	"	4234	851 Lamy.	{ 18. Cretaceous No. 1.	6451
606 Nepesta.	"	4354	869 Santa Fe. ⁴⁰	"	6937
616 Boone.	"	4458	868 Orteiz.	{ Lignitic Group.	5819
628 Baxter.			868 Los Cerrillos.	"	5604
634 Pueblo. ³⁸	18 b. Colorado.	4629	870 Waldo.	"	5246
579 Benton.	"		881 Wallace.	"	5087
588 Tempas.	"	4407	898 Algodones.	"	5031
599 Iron Springs.	"	4674	902 Bernalillo.	"	4919
607 Delhi.	"		910 Alameda.	"	4933
616 Thatcher.	"	5399	918 Albuquerque. ⁴¹	{ Base 18. Cret. Summits of 16. & 17. Jura Triass. alterg.	4881
625 Tyrone.	"	5318	928 Isleta.	"	4874
643 Holme's.	"	5704	931 A. & P. Junct. ⁴²	"	4831
652 Trinidad. ³⁹	18 d. Laramie.	5965	938 Los Lunas.	"	4784
658 Starkville. ⁴⁰	{ 18. Lignitic Group.	6331	948 Belen. ⁴³	"	4741
663 Morley.	"	6746	958 Sabinal. ⁴⁴		
New Mexico.					
662 Lansing.	"	7053			
676 Raton.	18. Cretaceous.	6620			
679 Dillon.	"	6454			
681 Otero.	"	6377			

thousand, composed of igneous rocks, granite, sienite, diorite, basalt, etc. On the higher mountains excellent pine timber grows; on the lower, cedars and sometimes oak; in the valleys of the Rio Grande, mezquite. The general dryness of the climate and the aridity of the soil will always confine agriculture to the valleys, by well-managed systems of irrigation; but water courses which contain running water throughout the year are very rare. There are, however, large tracts of land, too distant from water or too mountainous to be cultivated, which afford excellent pasture for millions of stock during the whole year, as horses, mules, cattle, sheep and goats, and no feeding in stables in the winter is necessary.

41. *Albuquerque*. On the east are rugged granite mountains. The country about the place is well cultivated by means of irrigation. It is astonishing how soon this apparently sterile soil is changed into the more fertile by affluence of water.

42. *Atlantic and Pacific Junction*. For the sake of continuity, the railroad from this point by the Needles to Mojave, is given in the chapter on California.

43. *Belen*. Mountain bluffs reach the Rio del Norte, and consist of black amygdaloidal basalt.

44. *Sabinal*. This book is strictly a geological work and not botanical, but it is well to note the beginning here in going south of two of the prevailing plants. The so-called *mezquite*, now first makes its appearance. It is thorny like a locust, bears yellow flowers and long pods, with a pleasant sour taste, and the wood is compact and heavy. The *mezquite* is the most common tree on the high plains of Mexico, and the pest of the country for travelers and forms the endless chaparral. Here it is but five or ten feet high, but in Mexico it is some times forty or fifty feet.

The other new plant is the *yucca*, resembling the palm tree with very fibrous, straight, pointed leaves. It is often the only tree growth visible in the desert, with its awkward branches terminated by tufts of its rigid lance-shaped leaves imparting a weird aspect to the landscape. It bears a cluster of white, bell-shaped, numerous flowers hanging down from their weight, one to two feet in length.

Atchison, Topeka and Santa Fe Railroad.			Atchison, Topeka and Santa Fe Railroad.		
Ms.		Alt.	Ms.		Alt.
981	Alamillo. ⁴⁵³⁴	The plains are chiefly 18. Cretaceous. The mountains in part Paleozoic probably Carboniferous limestones and in part eruptive.	1128	Las Cruces. ³⁸⁷¹	The plains are chiefly 18. Cret. The Mts. in part Paleozoic, etc.
994	Socorro. ⁴⁵⁶⁵		1140	Mesquite.	
1004	San Antonio. ⁴⁵¹⁷		1148	Lyndon.	
1011	Army. ⁴⁵¹³		1152	Anthony.	
			1161	Montoya. ⁴⁷	
1021	San Marcial.	4487	1172	El Paso, Tex. ⁴⁸	3713
1028	Pope.	4557	1096	Rincon, N. M.	4014
1037	Lava.	4708	1101	Hatch, N. M.	4433
1047	Crocker.	4707	1110	Sellers.	4493
1059	Engle.	"	1134	Florida.	4484
1067	Cutler.	4688	1142	Coleman.	4356
1079	Upham.	4537	1149	Deming. ³⁶	4327
1090	Gramma.	4323	1166	Crawford.	
1096	Rincon, N. M. ⁴⁶	4014	1173	Hudson.	
	Tonuco.	"	1180	White Water.	
1128	Dona Ana.	3899	1197	Silver City, N. M.	3771

Near Santa Fe it is from two to three feet high, but the larger species in Northern Mexico grow as trees of several feet in diameter and forty or fifty feet in height.

Mesquit or *Prosopis glandulosa* of Gray and Torrey, is a shrub or tree with thorny branches and desidious foliage, which is composed of thin and scattered leaflets, affording no protection from the heat. Its flowers are greenish white at first, and later yellow. The ripe pods are yellowish white, mottled with red, and the ripe beans are used for food by the Mexicans, and are eaten by animals. As fuel, the wood, both root and stem, is unsurpassed. The roots often afford much fuel when there is hardly any stalk, branches, or foliage. Of roots there are two kinds, some of them spreading laterally, while others are very long top roots. Large mesquite trees indicate the presence of water beneath. The mesquit flourishes in Arizona, New Mexico, Texas, and Mexico, its northern limit being the 37th parallel or the southern boundary of Colorado and Utah.

DR. V. HARVARD. U. S. A. in Am. Nat.

45. *Socorro*. The mountains consist principally of porphyritic rocks, with green trachyte.

At Lopez, six miles beyond Socorro, the mountains which have generally been ten to twenty miles distant now approach, and the bluffs consist of brown, nodular sandstone; south of this the hills are black basalt.

46. *Rincon*. The *Jornada del Muerto*, literally the day's journey of the dead man, which refers to an old tradition that the first traveler who attempted to cross it in one day perished on the way, was a part of the old Santa Fe road, 90 miles in length without any water in the dry season. The circuitous course of the river, with rough mountains along side of it, rendered it necessary to resort to this awful *Jornada*. As to the Colorado Desert, see in the California chapter notes Nos. 24, 25, 29, 30 and 31.

47. *Montoya, Organ Mountain*. The eastern mountain chain has a very broken pointed basaltic appearance, and is called the Organ Mountain, from the resemblance of the basaltic columns of its terminus to the pipes of that instrument.

48. *El Paso*. Note 13 on Texas.

THE DESERT FORMATION. To the traveler from the East, the desert country of the West and Southwest is surprising. The valley of the Mississippi, so called, lying between the Appalachian chain and the desert border of the Rocky Mountains, consists of each an expanse of fertile country, as can be found in one body, nowhere else on the face of the globe, producing all the fruits of the earth, including those found in every zone from the boreal regions to the tropics. The region west of the Mississippi Valley, and extending to the Coast Range of California on the contrary, is widely different, owing to the dryness of the climate and the presence of "alkalies" injurious to vegetation in extensive districts, and the physical structure of the surface formations often consisting of stratified pebbles and coarse sandy layers of great thickness. In these deep porous layers, rapidly absorbing the rain-fall, which is very small, leaving the surface an arid waste under a burning sun we see one important cause, in many places, of the desert character of this region, covering a vast extent of the great Southwest. Except on the borders of streams scarcely anything exists deserving the name of vegetation, in the absence of irrigation. But there seems to be hope for most of these deserts, as in other arid localities population and the cultivation of the soil increases the amount of rain-fall, while irrigation from the streams and artesian wells develop wonderful fertility from the soils of deserts.

This blank space is intended for additional geological notes in pencil by the traveler.

Nebraska.*

GENERAL NOTES ON THE GEOLOGY OF NEBRASKA.

1. A large number of the localities have been personally visited. For lines not traversed, careful consideration of published statements by Hayden, Meek, Aughey, and others, has been employed.

2. The Quaternary deposits may be grouped, in the order of formation, as follows: (a) Till or typical Boulder Clay, with numerous striated pebbles and boulders from the north. It is usually yellow or blue and "jointed." (b) Red Clay, showing commonly a red color and always more or less stratified but otherwise resembling till, into which it passes below. It sometimes shows few, if any pebbles in its upper portion. (c) Loess, a homogeneous stratified silt usually dull yellow or drab and commonly containing calcareous concretions, always cracked within. (d) A Red Loam, containing sometimes white, water-worn quartz pebbles. This deposit is found beyond the western limits of the till and red clay, underneath the Loess. It is frequently capped, as is also the Red Clay at some points, with a dark chocolate-colored earth, two to four feet thick, commonly called "the old soil." Beds of gravel and sand occur irregularly in all Quaternary deposits, except, perhaps, the Loess. In Knox county it is the prevailing drift deposit. The term drift is here used to indicate any deposit containing northern erratics referable to glacial origin.

A volcanic ash stratum, evidently deposited in Quaternary times, is widely deposited in Knox, Cuming, Lancaster, Seward, and Furnas counties, and along the Republican further west.

3. The Tertiary Deposits are not satisfactorily determined, especially in portions of the State most traversed by railroads. Hayden, Aughey, and others agree that the later Miocene, White River Group, and the Pliocene, Loup Fork Group, are both represented. But as they are conformable, quite variable in composition, imperfectly exposed, and fossils are rare, they are easily confounded. Hence the formations given in the table are largely provisional.

4. Another question in several cases is whether certain beds are Quaternary or Tertiary. Certain beds of silt or "silicious marl" do not clearly show whether they were deposited in Lake Cheyenne of the Pliocene age or in Lake Missouri, as we may call its successor or continuation in Quaternary times.

Ms. Burlington & Missouri River R. R. Alt.			Ms. Atchison and Nebraska Division. Alt.		
0 Plattsmouth.	Loess, 14 c. Up. Carb.		0 Lincoln. ⁸	1155	Loess, 18 a. Dakota Gr.
4 Oreapolis.	" " "	974	9 Saltillo.	" "	" ? 1178
9 Concord.	" " "		11 Roca. ⁹	1219	" 14 c. Up. Carb.
19 Louisville.	" " "	1040	15 Hickman.	" "	" 1347
81 Ashland. ⁵	18 a. Dak.,	1101	22 Firth.	" "	" 1319
43 Waverly.	" " "	1186	36 Sterling.	" "	" 1185
55 Lincoln.	1155 18 a. Cret. Dakota Gr.		49 Tecumseh.	" "	" 1112
65 Denton.	" " "	1247	63 Table Rock.	" "	" 1028
71 Berks.	{ Deep till over	1428	72 Humboldt.	" "	" 985
75 Crete.	{ 19 c. Pliocene? sand.		86 Salem.	" "	" 915
83 Dorchester. ⁶	18 b. Niobrara.	1368	92 Falls City.	" 14 b. Cl. Mres.	904
92 Friendville.	" " "	1578	111 White Cloud.	" "	858
108 Fairmont.	Loess. 19 c. Loup Fork ov. 19 b. White River Tertiary? 7	1656	(Continued in Kansas.)		
115 Grafton.		1699	Nebraska Railway Division.		
128 Sutton.		1689	0 Nebraska City.	Till, Loess, 14 Cl. M.	941
136 Harvard.		1812	11 Dunbar. ¹⁰	" " "	1081
151 Hastings.		1947	22 Syracuse. ¹⁰	" " "	1056
166 Kenesaw.		2088	34 Palmyra.	" " "	1181
176 Lowell.		2076	41 Bennet. ¹¹	" " "	"
182 Fort Kearney.		2150	47 Cheney's.	" " "	1485
191 Kearney Junc.			57 Lincoln.	1164	Loess, 18a. Dak. Group
			75 Germant'n.	1584	Till, Loess, 18 Cret.
			82 Seward.	" "	" 1445

5. Ashland. Fine exposure of Dakota sandstone a little east along the Platte.

6. Dorchester. Six miles northwest, in bank of West Blue, a stratum of volcanic ashes 1 to 5 feet thick with drift above and below. (See Note 2.)

7. Sutton. (See General Note 3.)

8. Lincoln. Loess and Till found overlying all, the latter not conspicuous throughout this line.

9. Roca. Fine quarries near station.

* By Prof. J. E. Todd, of Tabor College, Tabor, Iowa, Assistant Geologist, Glacial Division, U.S. Geological Survey.

Ms. Nebraska Railway Div.—Cont. Alt.				Nebraska Railway Division.			
				Northern Division—Cont. Alt.			
89	Tamora.	19 c. Pliocene. (Loup Fork ?) 20 Loess.	1559	29	Seward.	Dft., Loess, Niob. ?	1445
95	Utica.		1589	42	Ulysses.	Loess, 19c. W. Riv.	1524
102	Waco.		1627	50	Garrison.	" "	1602
109	York.		1642	56	David City.	" "	1619
117	Bradshaw.		1725	64	Bellwood.	Alluv.	1451
124	Hampton.		1770	74	Columbus.	" "	1492
131	Aurora.		1803	Eastern Division.			
142	Marquett. 1225	19 b. W. River, Loess.		0	Table Rock.	20 Loess and Drift, 14 c. Upper Coal.	1038
150	Central City. 1708	" Alluv.		7	Pawnee.		1180
142	Phillips.	Alluv., 19 b. White Riv.		19	Birchard.		1273
149	Grand Island.	" " 1871		28	Liberty.		1292
164	Hastings.	1947		39	Wymore.		1281
178	Kenesaw.	20 Loess, 19 c. 2088		48	Odell.		18 a. Dakota Group.
186	Hartwell.	Pliocene Sand over 19 b. White River.		57	Diller.	" "	1549
195	Minden.			66	Endicott.	" "	1291
205	Axtell.	20 Loess, 19 c. Plio- cene Sand ? over 19 b. W. Riv. ? 2079		72	Kesterson.	" Loess.	
219	Holdrege.			80	Reynolds.	" "	
235	Rouse.			90	Hubbell.	" " 1460	
240	Oxford Junc.			97	Chester.	" ? " 1621	
242	Oxford.			105	Harbine.	" ? " 1678	
Salem Branch.				114	Hardy.	18 b. Niobrara ?	1512
0	Falls City.	{ Loess and Drift. 904 14 b. Coal Mres. ? Loess and Drift, 14 c. Up. Coal Mres. ? 855		122	Superior.	" ? " 1574	
11	Verdon.			135	Guide Rock.	" ? " 1650	
17	Shubert.			142	Amboy.	" ? " 1698	
25	Nemaha.			146	Red Cloud.	" " 1690	
De Witt Line.				Republican Valley Branch.			
0	De Witt.	{ 20 Drift and 1299 Loess, 18 b. Niobrara Chalkstone.		0	Hastings.	{ 20 Loess, 19 c. 1947 Pliocene ? ss.	
15	Western.			12	Ayr.		" "	1847
23	Tobias.			19	Blue Hill.	" "	1978
Hebron Branch.				31	Cowles.	" "	1801
0	Chester. 1621	20 Loess, 18 a. Niob. ?		37	Amboy.	" "	1693
5	Stoddard.	" "		41	Red Cloud.	" "	1690
11	Hebron.	" "		49	Inavale.	Loess. 19 c. 1728 Pliocene ? over 1820 18 b. Niobrara. 1848 Chalkstone. 1944 19 c. Pliocene (Loup [Fork]?)	
Nemaha Line.				54	Riverton.		
0	Beatrice.	{ Drift and Loess. 18 a. Dakota. 1278 14 c. Upper Carb.		65	Franklin.		
21	Crab Orchard.			69	Bloomington.		
35	Tecumseh.	20 Drift and Loess. 14 c. Upper Carb.	1120	74	Naponee.		1878
48	Johnson.		1230	81	Republican.		1944
57	Auburn.		1052	87	Alma.		
67	Nemaha City.		885	93	Orleans.		" "	2079
72	Brownville.		894	120	Arapahoe.	" "	2177
79	Peru.		903	134	Cambridge.	" "	2262
85	Barney.			148	Indianola.	" "	2380
94	Nebraska City.		941	160	McCook.	" "	2511
Northern Division.				171	Culbertson.	" "	2578
0	Lincoln. 1155	Dft., Loess, 18 a. Dak.		193	Stratton, Neb.	" "	2500
7	Emerald.	" " " 1206		211	Benkleman.	" "	2975
13	Pleasant Dale.	" " " 1311		238	Haigler.	" "	3205
19	Milford. 1414	" " { 18 b. Ft. Ben- ton & Niob.		242	Laird.	" "	
24	Ruby. 1423	" " { 18 b. Ft. Ben- ton ? & Niob.		249	Wray, Col.	" "	2519
				257	Robb.	" "	
				264	Eckley.	" "	3879

10. Dunbar, Syracuse. Quarries within two miles.

11. Bennet. Quarries near, and Striae.

Joseph and Western Railroad. Alt.			Ma. Union Pacific Railroad—Continued. Alt.		
Harney Junc.	19b. W. Riv. Tert'y	2050	448 Bennett.	19 b. White Riv. Tert'y	
Stings.	"	1947	451 Antelope.	"	4712
enville.	" ?		468 Bushnell.	"	
irfield.	" ?	1780	473 Pine Bluffs.	"	5047
gar.	"		479 Tracy.	"	
venport.	18 b. Niobrara. ?	1660	484 Egbert.	"	
rleton.	" ?	1554	496 Hillsdale.	"	
lvidere.	" ?	1501	503 Atkins.	"	
exandria.	"	1508	508 Archer.	"	
irbury.	18 a. Dakota.	1316	516 Cheyenne.	(See Wyoming.)	6059
ele City.	"	1269			
Union Pacific Railroad.			Omaha and Republican Valley Branch. Nebraska Division.		
aha.	14 c. Upper Carb.	1089	0 Valley.	1149 Alluv., 18 a. Dak. ss.	
lmore.	"	998	7 Clear Creek.	Loess, " ?	1188
llard.	"	1078	19 Wahoo. ¹⁴	" " ?	1188
sterloo.	"		27 Weston.	" " ?	1261
emont. ¹²	18a. Cret. Dak. Gr.	1203	88 Valparaiso.	{ Drift, Loess, 1816	
nberly.	"			{ 18 b. Niob. Chalkst.	
gers. ¹⁸	18b. Ft. Benton & Niob.		47 Raymond.	{ Loess, 19c. Plioc.	1158
huyler.	"		58 Lincoln.	{ cene sand and clay.	
chland.	"	1350	66 Jamaica.	Dft., Loess, 18a. Dak. ss.	
lumbus.	19 c. White River.		69 Hanlon.	" " ?	
ckson.	"		80 Cortland.	" " ?	
ver Creek.	"	1555	90 Pickrell.	" " ?	
ark's.	19 b. W. Riv. Tert'y	1628	98 Beatrice.	{ Dft., Loess, 18a. 1261	
ntral City.	"			{ Dak. ov. 14c. U. Carb.	
apman's.	"	1775	112 Blue Springs.	"	
and Island.	"	1871	119 Otoe Agency.	"	
da.	"	1922	125 Oketo.	" ?	
ood River.	"	1996	186 Marysville, Kan.		
bbon.	"	2067	88 Valparaiso.	{ Drift, Loess, 1816	
arney Junc.	"	2187		{ 18b. Niob. Ch'kstone	
evenson.	"		51 Brainard.	Drift, ? Loess.	1687
m Creek.	"	2273	61 David City.	"	1619
erton.	"	2326	71 Risings.	1597 Loess, 19c. Plioc. sand.	
um Creek.	"	2394	78 Shelby.	" " "	
yote.	"		85 Osceola.	" " "	1643
illow Island.	"	2529	90 Stromsburg.	" " "	1636
arren.	"				
ady Island.	"	2667	Omaha, Niobrara and Black Hills Branch.		
cPherson.	"	2695	0 Norfolk.	Till, Loess, 19 Tert.	1533
orth Platte.	"	2808	5 Munson.	Loess, 19 c. Plioc.	1595
chols.	"	2920	15 Madison.	" " "	1585
xter.	"	3000	24 Humphreys.	" " "	1650
ascoe.	"		36 Platte Center.	" " "	1537
alalla.	"	3216	41 Lost Creek.	Alluvium, " "	1500
ule.	"		50 Columbus.	" " "	1453
g Spring.	"	3371	9 Lost Creek.	" " "	1500
appel.	"		20 Genoa.	" " ?	1584
dge Pole.	"	3833	31 St. Edwards.	"Loess" ?	1666
lton.	"		43 Albion.	Loess, 19b. W. R. ?	1756
dney.	"	4095	0 Genoa.	" 19c. Plioc. ?	1884
ownson.	"	4200	13 Fullerton.	" ?	
atter.	"	4366	30 Cedar Rapids.	" ?	

Fremont. Very fine exposures of Till, Red Clay, Old Soil and Loess in bluff south of the 2 to 5 miles southwest. A high terrace extends along north of the Platte from Kearney to at.

Rogers. Fort Benton exposed 5 to 8 miles south near Linwood and Skull Creek.

Wahoo. On west bank of an old valley of the Platte.

Union Pacific Railroad—Continued.				Missouri Pacific Railroad.			
Ms.	Grand Island and North Loup Br.	Alt.		Ms.		Alt.	
0	Grand Island.	20 Alluvium.	1871	379	Reserve, Kan.		
47	Scotia.	{ Loess, 19 c. Pliocene		384	Falls City, Neb.	{ 20 Drift & Loess, 14 c. Up. Carb.	984
49	North Loup.	{ over 19 b. White Riv.		394	Verdon,		
				401	Stella.		
				408	Howe.		
				414	Auburn.	{ Drift, Loess,	1052
				418	Glen Rock.	{ 14 c. Upper Carb.	
				423	Brook.		
				427	Talmadge.		
				432	Delta.		
				337	Dunbar.		1051
				444	Berlin.		
				449	Avoca.		
				455	Weeping Water.		
				465	Louisville.		1040
				471	Springfield.		
				481	Papillon.		1005
				486	Gilmore.		999
				496	Omaha.		1039
Sioux City and Pacific Railroad.				Chic., St. Paul, Minneapolis & Omaha R. R.			
Ms.	Elkhorn Valley Line, Nebraska Div.	Alt.		Nebraska Division.			
0	Mo. Valley, Ia.	20 Alluvium.		0	Sioux City.	Till, Loess, 18 a. Dak.	
12	S.C. & P. Bridge ¹⁵	20 Dft. and Loess.	1100	2	Covington.	Alluvium,	1124
13	Blair.	" "	1157	7	Dakota City.	" "	1121
20	Kennard.	{ 20 Drift and Loess,	1175	12	Coburn Junc.	" Loess,	1124
29	Arlington	{ 18 a. Dakota.	1211	16	Hubbard.	Loess, 18 b. Niob.	1161
38	Fremont.	{ 20 Alluv. and Loess, 18a. Dak.	1266	29	Emerson.	" "	1450
46	Nickerson.	{ 20 Till and Loess,	1326	51	Bancroft.	" " ?	1316
53	Hooper.	{ 18 b. Niobrara.	1423	58	Lyons.	" " ?	1306
61	Scribner.	{ Till, Loess, 19 Tertiary.	1532	65	Oakland.	" " ?	1300
73	West Point. ¹⁶	" ?	1532	81	Tekamah.	Till, 18 a. Dakota.	1075
89	Wisner.	" ?	1532	98	Blair.	{ Drift, Loess,	1100
96	Pilger.	" ?	1532	102	De Soto.	" " ?	1100
106	Stanton.	" ?	1532	104	Mills.	" " ?	
117	Norfolk Junc.	" ?	1532	107	Calhoun.	" " ?	1327
117	Norfolk Junc.	" ?	1532	122	Florence.	" "	
119	Norfolk.	" ?	1532	128	Omaha.	" "	1039
124	Hadar.	" ?	1532	12	Coburn Junc.	See above.	1124
132	Pierce.	" ?	1532	15	Jackson.	Drift, Loess, 18 a. Dak.	
140	Morehouse.	" ?	1532	28	Ponca. ¹⁸	{ " " " 18 b. Niobrara.	
149	Plainview.	" ?	1532				
159	Creighton.	{ Drift and Loess, 19 c. Pliocene (Loup) over 19 b. White River.					
128	Battle Creek. ¹⁷	20 Loess, 19 c. Pliocene ? sands over 19 b. White Riv. ?	1602				
140	Burnett.	" "	1691				
147	Oakdale.	" "	1722				
152	Neligh.	" "	1761				
171	Ewing.	" "	1875				
192	O'Neill.	" "	1992				
200	Emmett.	" "	2039				
210	Atkinson.	" "	2125				
219	Stuart.	" "	2171				
229	Newport.	" "	2249				
240	Bassett.	" "	2340				
250	Long Pine.	" "	2416				
259	Ainsworth.	" "	2538				
269	Johnstown.	" "	2618				
280	Woodlake.	" "	2704				
287	Arabia.	" "	2735				
299	Thatcher.	" "	2669				
306	Valentine.	" "	2598				

15. S. C. & P. Bridge. 14 c. Upper Carboniferous limestone 50 feet below low water.

16. West Point. A fine exposure of more than 100 feet vertical 5 miles northwest, showing Loess, Red Clay, Volcanic Ash (6 feet) and Till. Chalkstone struck in wells at West Point.

17. Battle Creek. "Yellow Banks," a cliff of 60 to 70 feet of sand above as much bluish clay, both without fossils, 3 miles northwest.

18. Ponca. A seam of lignite at the ferry landing

Colorado.

BY S. F. EMMONS, UNITED STATES GEOLOGIST.

GEOLOGICAL FORMATIONS IN COLORADO.

20. Quaternary.	17. Jurassic.
	16. Triassic.
19. Tertiary.	14. Carboniferous. { 14 c. Upp. Cl. Mres. 14 b. Weber Grits. 14 a. Low. Carboniferous.
18. Cretaceous. { 18 d. Laramie (Lignitic of Hayden.) 18 c. Fox Hills. 18 b. Colorado. 18 a. Dakota.	5-7 Silurian.
	2. Cambrian.
	1. Archæan.

GEOLOGY OF COLORADO.

Certain broad general features of the geology of Colorado are comparatively simple and, owing to the climatic conditions of the region which leave the rock exposures relatively unobscured, can be easily recognised by the geological tourist. The details of structure for any particular region are, on the other hand, as a rule extremely complicated and have only been worked out over limited areas. Even were they fully known it would not be practicable to explain them in the restricted space of the present guide. The notes given above, therefore, must be understood as only indicating these broad and easily recognisable features. In some few cases, moreover, the country has not been visited since the respective railroads have been built, and in such cases the geological indications given may not be strictly applicable to the actual location of the given railroad station; in other cases there may still be some doubt as to the exact subdivision of a geological formation which is exposed at a given point. It is believed, however, that such cases are sufficiently explained by the accompanying notes to avoid leading the observer into any serious error. The Hayden atlas of Colorado gives a most excellent idea of the general distribution of geological formations throughout the state whenever these notes differ therefrom it is because later and more detailed studies have enabled the writer to make such later corrections, as would naturally be called for in a work of so general a character as that necessarily was.

GENERAL STRUCTURE.

In physical structure this region may be divided into a mountain area and plain areas which border it both on the east and west sides. The plain areas and many of the broad valleys, included within the mountain area proper, show as a rule only exposures of Mesozoic, generally Cretaceous, strata, or of overlying Tertiary beds, either of which may be completely obscured by later Quaternary deposits. In the mountain area on

the other hand are found the original Archæan rocks, which form the base of all the deposits, and some considerable areas of upturned Palæozoic beds, and of eruptive rocks. Along the immediate flanks of the mountains, especially on the east flank of the Colorado or Front Range, the upturned Mesozoic strata often form fringing reefs, popularly called "Hogback" ridges, approximately parallel with the shore line of the sea in which they were originally deposited. Large areas of Archæan rocks have undoubtedly never been entirely submerged since Archæan times, and everywhere, where erosion has gone deep enough, they are exposed as the base rock.

While the view of earlier geologists that the time of principal uplift in this region was at the close of the Cretaceous still holds good, evidence has recently been found in local nonconformities, of subsidence and elevation both previous and subsequent to this period.

ARCHÆAN FORMATIONS.

These consist of granite, granite-gneiss, micaceous and hornblendic gneisses and amphibolites. The granite is sometimes found as an immense central mass upon which the more distinctly stratified members of the formation are apparently resting; again as distinctly eruptive or intrusive masses penetrating these members, and still again as a constituent part of them, sharing in their bedded structure. Granite has never yet been found in Colorado penetrating later formations than the Archæan, although some later eruptives have so crystalline a structure that they might on hasty examination be considered to be granite. Granite-gneiss is the name given to a very common development among these rocks in which, while the component minerals are foliated, the rocks have still the massive structure of granite. The true gneisses vary from the extreme micaceous to the extreme hornblendic type, and the amphibolites are massive rocks composed almost exclusively of hornblende. Less crystalline rocks than the above, if present, are very rare, and as yet no limestones whatever have been found among these rocks. For one who wishes to make a study of this oldest known geological formation, which presumably represents the first rock crust of the globe, no better field can be found than is afforded by the many deep cañon exposures of Colorado.

PALEOZOIC FORMATIONS.

These are much thinner in Colorado than in Nevada or in the Eastern states. The Cambrian which is the lowest formation found in contact with the Archæan consists of a few hundred feet of saccharoidal quartzites, generally white, and passing up into shaly and more or less calcareous beds carrying fossils of the Upper Cambrian. A still lower unconformable series of beds, about ten thousand feet in thickness and later than the Archæan, has been observed by the writer at a single locality in the state but not on the line of any railroad. Above the Cambrian are a few hundred feet of light colored siliceous limestones, of ten magnesian, sometimes greenish or pinkish in color, whose fauna corresponds to that of the Pogonip, or Silurian limestone of Nevada.

The Devonian is apparently wanting in Colorado, as the beds found immediately overlying the above, generally a blue gray limestone or dolomite, carry lower Carboniferous fossils. There is some evidence of a nonconformity by erosion in the upper part of the Silurian which would explain the local absence of Devonian formations. The Carboniferous formation has a greater aggregate thickness than all the other Palæozoic formations combined. The lower Blue limestone above mentioned is generally succeeded by black shales and these by a very considerable thickness, amounting to two or three thousand feet, of sandstones and conglomerates with subordinate beds of black shale and limestone, locally known as the Weber Grits. Thin beds of impure anthracite are sometimes found in the lower part of this formation. Its prevailing colors are gray or red. The upper part of the Carboniferous formation is of similar constitution, generally with an increasing proportion of calcareous beds and of coarse red sandstones, which are often difficult to distinguish from the immediately overlying Permian sandstones of the Trias. Gypsum is found in these upper beds. No unquestionably Permian fauna has yet been found in Colorado.

MESOZOIC FORMATIONS.

The Trias is represented by a series of coarse red sandstones and conglomerates, the former often strikingly crossbedded, which are everywhere prominent by their brilliant coloring. Organic remains are apparently almost entirely wanting in these beds, for which reason it is impossible to draw a definite dividing line between this and the preceding or succeeding formation.

The Jura consists of a gray or buff sandstone at base, often crossbedded, succeeded by shales of variegated colors, with lenticular secretions of limestone which sometimes form a distinct and prominent bed. This formation is locally well defined by both molluscan and vertebrate remains.

The Cretaceous is the most important of the Mesozoic formations and is subdivided into four members. The Dakota at the base is characteristically a heavy bedded sandstone or quartzite, carrying a peculiar conglomerate bed at its base. The formation also includes some beds of shale, and on the eastern slopes of the mountains carries beds of remarkable pure fire clay. The Colorado next above is essentially a clay formation, its clays being black when freshly opened and bleaching upon exposure; its topography hence is quite characteristic. It generally carries a bed of light colored limestone, which is known as the Niobrara limestone, being characteristic of the sub-division of that name formerly made by Dr. Hayden. The Fox Hills and Laramie sub-divisions which succeed consist of alternating friable sandstones and clays, and are only distinguishable from each other by their molluscan remains, which in the former are marine, in the latter brackish, or fresh water. The Laramie formation has been formerly considered Tertiary by some geologists on account of its fauna, but later investigations have shown it to be more properly the closing member of the Cretaceous from a paleontological point of view, while its stratigraphical relations have always associated it with the Cretaceous. It is the coal-bearing formation of the West, most all the known coal deposits whose horizon has been accurately determined having been found to belong to it, while of those not yet thoroughly studied some have been provisionally assigned to the Fox Hills.

TERTIARY FORMATIONS.

There are many detached remnants of fresh water Tertiary formations in Colorado, the relations of which to each other have not yet been thoroughly worked out, nor in most cases have their ages been satisfactorily determined. In the above notes therefore they have not been assigned to any definite subdivision, and the local names are given only when they are sufficiently known to justify it.

QUATERNARY FORMATIONS.

These have likewise not been subdivided, though it is evident that there were several distinct periods of deposit. They have been indicated in the notes only where they obscure the underlying formations that the latter can be determined either not at all or only with considerable uncertainty.

ERUPTIVE ROCKS.

These form a most important feature in the geology of Colorado. In the Archean rocks they occur as narrow dikes of porphyry, diorite and diabase. In the Paleozoic and Mesozoic formations are laccolitic masses and immense intrusive sheets of porphyry, porphyrite and diorite whose principal time of eruption was just preceding and subsequent to the Post Cretaceous upheaval. Among later Tertiary and recent eruptive rocks are found hornblende and hypersthene andesites, basalts, rhyolites and less frequently trachytes. The larger areas of recent surface flows are found in the southwestern part of the State. Here are extensive bedded masses of breccia, formerly considered trachytic but probably in large part, if not entirely, andesitic.

MINERALS.

Colorado is exceptionally rich in rare and precious minerals. The best known locality is in the Archean area around Pike's Peak, extending west as far as Florissant and north to Platte Mountain. Here are found very fine topaz, amazon-stone, zircon and phenacite crystals and a very complete series of cryolite minerals, hitherto known only in Greenland. Boulder county is famous for its great variety of Telluride minerals, many new to science. Topaz is also found in the Arkansas valley, in druses in the rhyolite of Nathrop and Chalk Mountain, associated in the former locality with fine clear garnets. A great variety of silver, copper and bismuth minerals have been obtained from various mining districts. The San Juan and Elk Mountains offer a most attractive field for the mineralogical explorer and have already yielded many new and rare mineral species.

PRECIOUS METALS.

In the value of its product of precious metals Colorado ranks first among the States. Its average annual product may be estimated in round numbers at four million dollars in gold and sixteen millions in silver (coining value). Of this value the single district of Leadville produces more than half. In other metals its most important products have been lead and copper, amounting in a single year to 70,000 tons of the former metal and a thousand tons of the latter. Its ores present every variety of mineralogical composition, but that which produces the greatest aggregate value is argentiferous galena and its secondary products.

In geological distribution the ores are as diversified as in their mineralogical constitution. In the Archean are found the Telluride ores of Boulder County, the auriferous pyrites of Gilpin County, the argentiferous galena and other silver minerals of Clear Creek and Hall's Valley, and deposits in in the Wet Mountain valley, the Mosquito, Sawatch and other ranges. Ores have been extracted from the Cambrian and Silurian in the Mosquito Range, at Red Cliff, at Ouray and possibly at other localities. From the Lower Carboniferous limestone is derived most of the ore of Leadville, of Red Cliff, Aspen, Monarch, Ouray and other mining districts. At the Ten Mile district and in various parts of the Elk Mountains and San Juan Mountains ores are obtained from the upper horizons of the Carboniferous. Some of the ores from the vicinity of Breckenridge and of the San Juan region come from Triassic horizons, while those in the vicinity of Irwin, Gunnison County, and probably of several other regions not yet examined, are found in Cretaceous rocks. While eruptive bodies in some form are an almost invariable accompaniment of the valuable concentrations of ore in Colorado, the ore itself is rather more frequently found in the associated sedimentary rocks, especially when the latter are calcareous. Important deposits are found, however, in the eruptive rocks themselves, notably in the San Juan region, in Summit District, Rio Grande County and in Wet Mountain Valley, (Rosita and Silver Cliff); moreover the so-called fissure veins in the Archean are sometimes only mineralized dikes of eruptive rock.

COAL AND IRON.

Although the development of these more useful minerals is still in its infancy, amounting to a million and a quarter tons of the former, and 25,000 tons of the latter, the natural resources of the State are most extensive. The coal horizons surround the mountains on every side and penetrate many of the interior valleys, while many deposits of iron ore have already been discovered, although the industrial conditions have not yet developed a very active search.

Scenery. Colorado presents several types of scenery, each in its way of great interest. On the east are the great treeless plains, sloping imperceptibly towards the Mississippi valley. Their soil is naturally rich, but, owing to the slight rainfall, only that portion which can be irrigated is available for agriculture, the balance being utilized as pasture for cattle and sheep. Facing the plains is the Colorado or Front Range, whose trend is nearly north and south and which is cut by the deep cañons of draining mountain streams, utilized by the various railroads which reach the interior. Back of this are a series of mountain valleys, the principal of which are the Wet Mountain Valley, San Luis Park, South Park, Middle Park and North Park; all but the last of these are penetrated or traversed by railroads. West of these is a second series of mountain ranges forming the general line of elevation known as the Park Range, but which is less regular in structure than the Colorado Range. Opposite the South Park it is split into two ranges, the Mosquito and the Sawatch, by the deep

longitudinal valley of the Upper Arkansas River. West of these two systems of elevation stretches the Mesa region of the basin of the Colorado river, characterized by its intricate network of deep, narrow cañons cut through soft horizontal strata, which finds its most striking development beyond the boundaries of the state, in Utah and Arizona. Detached mountain masses stretch out on the western flanks of the ranges above mentioned into this plateau region. Of these the most important are the San Juan Mountains and the Elk Mountains, on the south and north of the Gunnison River respectively, which are largely composed of eruptive rocks, and some smaller masses such as the Sierra La Sal, etc., which apparently owe their elevation entirely to eruptive action. Types of the varied scenery of these various regions can be seen from the railroad itself, but a far better knowledge is obtained by short excursions which can be readily made from various central points.

From Denver excursions may be made 1st to Estes Park, 75 miles north, (two hours by rail and four hours by stage) a most beautiful mountain valley in the granite mountains, and the only one to which the name "Park," as it is understood outside of Colorado, is properly applicable. A good hotel and various rancho boarding houses afford accommodations to the tourist and a great variety of excursions may be made on horseback or in wagon. Long's Peak, the most precipitous in the Colorado Range, can be easily ascended on foot by those whose nerves are sufficiently steady. The air is dry, cool, yet mild, and peculiarly healthful. Its elevation is about 8,000 feet.

2nd. By rail to Boulder and thence by wagon or on horseback to the famous Telluride mines of Boulder County.

3rd. By rail past the volcanic mesas of Golden, up Clear Creek Cañon to the mines of Central City and by Idaho Springs (thermal baths) to Georgetown; from Graymont, the terminus, it is an easy two-hours' walk or ride to the summit of Gray's Peak.

4th. By rail to Morrison—upturned Mesozoic strata, carrying gypsum and remains of *Atlanta saurus*.

5th. By the Denver and South Park Railroad up the Platte cañon to the South Park. Thence either across Mount Guyot to Breckenridge, and up the Ten-Mile valley to Leadville, or southwest across South Park to Buena Vista in the Arkansas Valley, and over the Sawatch Range, by the Alpine Pass, to Pitkin and Gunnison.

6th. By the Denver and Rio Grande to Palmer Lake (summer hotel and pleasure grounds) on the divide between the South Platte and the Arkansas rivers and close to the foot hills of the Colorado Range.

The metallurgist will be repaid by a visit to the Argo (copper) and Grant (lead) smelting works on the outskirts of Denver.

From Colorado Springs (excellent hotel—"The Antlers"). By carriage or rail (four miles) to Manitou, the fashionable summer resort of Colorado. Many hotels. Iron and soda (effervescent) springs. Caverns in the Silurian limestone. Ute Falls (granite). Garden of the Gods (upturned red sandstones). Glen Eyrie (residence of General Palmer), with picturesque gorge in Archæan and Cambrian just back of the house. Ascent of Pike's Peak (station of the U. S. Signal Service on the summit) can be made in a day either on foot or on horseback. Drive across Ute Pass to Manitou Park, a pretty mountain valley containing a remnant of Cambrian and Silurian strata, deposited in a bay of the original Archæan land mass, which have escaped erosion. Near Cheyenne Mountain are found the rare cryolite minerals, and south of Manitou near Florissant amazon stone, topaz and phenacite.

The projected Midland Railroad (broad gauge) starting from Colorado Springs will cross the Ute Pass, traverse the lower part of South Park, crossing the Mosquito Range (Palæozoic and Archæan) to Leadville, and thence across the Sawatch Range (Archæan) to Aspen (silver ores in lower Carboniferous limestone) on the Roaring Fork of Grand River.

Pueblo is of more importance as an industrial centre, than from a picturesque point of view. To it are tributary the Cañon City coal fields, and those worked by the Atchison, Topeka & Santa Fe R. R., and the Denver & Rio Grande Railway in the vicinity of Trinidad and El Moro, while the various interior railroad lines centering here communicate with the principal mining districts of the state. Two large lead smelting works and one Bessemer plant are already established in its immediate vicinity.

From Pueblo railroad lines run south, southwest, west, north and east. South, the Atchison, Topeka & Santa Fe leads to New Mexico, and the southern overland route. Southwest, the D. & R. G. Railway crosses the La Veta pass, just north of the Spanish Peaks and south of Blanca Peak, into the broad alluvial valley of San Luis Park. From Alamosa a branch follows up the Rio Grande river to Wagon Wheel Gap, now a favorite summer resort; another branch runs south down the same river into New Mexico; while the main line crosses a low range of eruptive rocks resting on Archæan, past the Toltec gorge, and then crossing the Cretaceous and Tertiary plains of the basin of the San Juan River to Durango (coal mines and smelting works), penetrates the San Juan Mountains through the magnificent gorge of the Animas, having its present terminus at Silverton in Baker's Park. This is the centre of the boldest and most precipitous mountain mass in Colorado, as well as of many important mining districts. The Alpine climber will here find many untried peaks to test his prowess; the geologist many problems to solve, and the mineralogist an endless variety of mineral species to be determined.

Westward. The main artery of the D. & R. G. Railway reaches the mountains at Cañon City (State Penitentiary, Hot Springs and bath, Soda Springs, Lead smelting works, Limestone quarries, and petroleum wells in the country around). From here a branch runs southwest through the narrow gorge of Grape Creek to Wet Mountain valley and the mines of Silver Cliff. The main line follows up the Arkansas river through the magnificent cañon, known as the Royal Gorge, and through minor valleys cutting across the north end of the Sangre de Cristo range and the south end of the Mosquito Range to Salida at the junction of the South Arkansas with the main stream. From Salida the original line follows the fine north and south valley of the Upper Arkansas, carved mainly out of Archæan granite, to Leadville, the great silver mining centre. From Leadville the beautiful Twin Lakes, formed by the damming up by terminal moraines of a mountain stream issuing from a deep gorge in the Sawatch Range, can be reached in a drive of 16 miles. A good macadamised road leads across the Arkansas valley (six miles) to Soda Springs, at the foot of Mount Massive (14,298 feet). Beyond Leadville, branches of the D. & R. G. Railway cross the Continental divide to the

Union Pacific Railway.			Union Pacific Railway.		
Ma.	Denver and South Park Division.	Alt.	Ms.	Denver and South Park Division.—Com.	Alt.
0	Denver. ¹	20. Quaternary. 5175	88	Como. ⁸	{ 20. Quater. over Laramie Cretaceous.
1	West Denver.	" 5179	94	Red Hill.	18 b. Colorado.
3	Auraria.	"	103	Arthur's.	"
7	Mooreville.	"	104	Garos.	"
7	Bear Creek.	" 5547	105	Garos.	"
11	Littleton.	" 5550	115	Fairplay. ¹⁵	16. Trias. 9941
17	Wheatland. ¹	"	120	London.	1. Archæan.
21	Platte Cañon. ³		113	Platte River. ¹⁶	20. River Bottom.
27	Deansbury. ³	1. Archæan.	120	Hill Top.	{ 14. Carboniferous Limestones.
29	South Platte. ⁴	" Granite. 5049	127	McGee's.	1. Granite.
32	Dome Rock.	"	132	Charcoal.	"
35	Dawson's.	"	133	Schwanders.	"
40	Buffalo.	"	137	Buena Vista.	{ 20. Quaternary over Archæan.
42	Pine Grove.	"	138	Schwanders.	1. Archæan.
48	Crosson's. ⁴	"	137	Nathrop. ¹⁷	{ 20. Quaternary over Archæan.
52	Estabrook. ⁵	"	142	Hortense.	1. Granite.
55	Bailey's.	" 5491	149	Alpine.	"
59	Slaght's.	"	153	St. Elmo's.	"
62	Meadows.	"	155	Murphy's.	1. Archæan.
66	Grant. ⁵	" 5491	175	Pitkin. ¹⁸	"
69	Webster. ⁶	"	190	Parlins.	20. Quaternary.
74	Hoosier. ⁷	" 9905	202	Gunnison.	"
76	Kenosha. ⁷	"	216	Baldwin.	18 d. Laramie.
81	Jefferson.	{ 20. Quaternary 9905 over Laramie.	219	Baldwin Mines.	"
88	Como. ⁸	"	Colorado Central Branch—Colorado Division. Broad Gauge.		
94	Halfway.	Quartz-porphry.	0	Cheyenne.	
97	Selkirk.	"	6	Colorado Junct.	{ 19. Niobrara 9914 Pliocene.
99	Boreas. ⁹	"	13	Lone Tree.	"
101	Dwyer.	16. Red Sandstone.	24	Taylor's.	18 c. Fox Hills.
104	Argentine. ¹⁰	18. }	32	Bristol.	"
106	Mayo. ¹⁰	18. }	40	Fort Collins.	"
110	Breckenridge. ¹¹	Quaternary.	63	Loveland.	18 b. Colorado.
114	Broncho.	"	71	Berthoud.	"
116	Dickey. ¹¹	"	80	Longmont.	"
120	Frisco.	{ 20. Quaternary over Archæan.	85	Niwat.	"
122	Curtin. ¹²	"	92	Boulder.	18 c. Fox Hills. 5308
126	Wheeler.	"	100	Louisville. ¹⁹	18 d. Laramie.
133	Kokomo.	14 c. & porphyry. 10609	110	Church's.	"
134	Robinson.	" 10849			
137	Climax.	14 b. Webber Grits.			
139	Alicants. ¹³	10. Archæan. 11148			
144	Bird's Eye. ¹³	14b. & porphyry. 10161			
151	Leadville. ¹⁴	{ 20. Quaternary Lake beds. 10178			

north, one descending Eagle River to the mining town of Red Cliff, the other the Ten-Mile river to the Middle Park, each valley being extremely precipitous and picturesque.

From *Salida* again, the present main line goes westward, past Poncho Springs (Thermal baths), sending off a short branch to the northwest to the Monarch mining district, and southward across Poncho Pass into the San Luis Valley and the iron mines at Hot Springs. The main line crosses the south end of the Sawatch range by the Marshall Pass and follows the Gunnison river down to the Utah boundary line. From Gunnison City (La Veta Hotel) a branch runs north to Crested Butte, a good centre for visiting the wild and beautiful scenery of the Elk Mountains, and the mines of anthracite and bituminous coal, of silver, copper and lead. The forest growth and vegetation is generally more luxuriant on these western slopes than on the east flanks of the mountains. Below Gunnison the railroad passes part way through the cañon of the Gunnison (known as the Black cañon) and then diverges to the south into the Uncompaghe valley. From Montrose in this valley the San Juan mountains may be reached by stage by way of Ouray, probably the most picturesquely situated town in the state. Further westward the country assumes the somewhat monotonous but striking appearance characteristic of the Colorado plateau region.

Union Pacific Railway.			Union Pacific Railway.		
Colorado Central Branch—Colorado Division.			Denver Pacific Branch		
Ms.	Broad Gauge—Con.	Alt.	Ms.	Colorado Division.	Alt.
118	Ralston. ²⁰	18 d. Laramie.			
121	Jones' Siding.	{ 19. Moniment Creek Tertiary.	0	Denver.	{ 20. Quaternary ⁵¹⁷⁵ over Denver Tertiary.
122	Golden. ²¹	18 d. Laramie. 5684	2	Jersey.	"
130	Arvada.	20. Quaternary 5323	7	Hatchery.	"
136	Argo. ²⁶	over Denver	14	Henderson.	" 5611
188	Denver.	Tertiary. 5175	19	Brighton.	18 d. Laramie.
Narrow Gauge.			26	Lupton.	"
0	Denver.	20.	35	Platteville. ²⁹	"
16	Golden. ²²	18 d. Laramie. 5684	41	Hautes.	"
19	Chimney Gulch.	1. Archæan. ²³ 5909	46	La Salle.	"
22	Guy Gulch.	" 6212	48	Evans.	{ 20. Quaternary ⁴⁶¹¹ River Bottom.
24	Beaver Brook.	" 6391	52	Greeley.	" 4611
28	Big Hill.	" 6328	60	Eaton.	18 d. Laramie.
29	Forks Creek.	" 6378	67	Pierce.	"
31	Cottonwood.	" 7178	76	Dover.	"
34	Smith Hill.	" 7626	86	Carr.	" 5694
36	Black Hawk. ²⁴	" 8031	96	Athol.	{ 19. Niobrara Pliocene.
40	Central City. ²⁴	" 8484	Boulder Branch.		
Georgetown Branch.					
29	Forks Creek.	1. Archæan.	0	Denver.	{ 20. Quaternary ⁵¹⁷⁵ over Denver Tertiary.
33	Floyd Hill.	" 7201	"		
38	Idaho Springs.	" 7541	2	Jersey.	"
45	Lawsons.	" 8111	7	Hatchery.	"
51	Georgetown. ²⁵	" 8474	14	Henderson.	"
56	Silver Plume.	" 9074	19	Brighton.	18 d. Laramie. 5034
60	Graymont. ²⁶	"	26	Dick.	"
Omaha and Denver Short Line.			30	St. Vrain.	"
(Continued from Nebraska.)			34	Erie. ³⁰	"
861	Big Springs. ²⁷	20. Quaternary.	35	Northrop. ³⁰	"
869	Barton.	" 5134	36	Canfield. ³⁰	"
871	Denver Jc. (formerly Julesberg.)	"	40	Clifton.	18 c. Fox Hills.
886	Sedgewick.	"	43	Vochmont.	18 c. Ridge of Solerite.
400	Crook.	"	46	Boulder.	18 c. Fox Hills.
417	Iliff.	"	Boulder and Carbon Branch.		
429	Sterling.	"	0	Boulder.	18 c. Fox Hills. 5868
441	Merino.	"	6	Marshall. ³⁰	18. Laramie. 5539
458	Snyder.	"	Morrison Branch.		
471	Denel.	"			
480	Orchard.	"	0	Denver.	{ 20. Quaternary ⁵¹⁷⁵ over Denver Tertiary.
506	Hardin.	"	1	West Denver.	"
522	La Salle. ²⁷	"	7	Mooreville.	"
533	Platteville. ²⁸	" 4812	8	Bear Creek.	"
541	Lupton.	" 4896	10	Gilman.	"
549	Brighton.	" 4979	13	Mt. Carbon.	18 d. Laramie.
554	Henderson.	"	16	Morrison. ³¹	18 a. Dak. 17. Juras.
556	Jersey.	" 5175			
569	Denver. ²⁸	"			

1. *Denver to Wheatland.* The road follows Platte Valley bottom, and edges of benches formed of Denver Tertiary underlain by Laramie Cretaceous.

2. *Platte Canon.* 16, 17, 18 a., 18 b. Hog back ridges of Cretaceous sandstones and Jurassic limestones. Sections from Ft. Benton to Trias, inclusive, from a point one mile east to a point one half mile west of station.

3. *Deanebury.* Granite gneiss and amphibolites.

4. *South Platte to Crosson's.* Massive red granite throughout this distance. In part disintegrating.

readily on exposure to the atmosphere, in part resisting disintegration and making handsome building stone. Quarries near Buffalo Station.

5. *Eatatabook—Grant*. Granite gneiss, schists (some amphibolites) and gray granite.
6. *Webster*. Branch Valley leads to Geneva district and Hall Valley mines. Bismuth silver ores.
7. *Hoosier—Kenosha*. Gray granite and some eruptives.
8. *Como*. Coal mines west of town. At Hamilton, higher up Tarryall Creek, are abandoned gold placers. Here was the first discovery of gold in Colorado west of the Colorado range.
9. *Borcas*. Mt. Guyot to the east, almost entirely made up of eruptive rocks, with a few caught up fragments of sedimentary beds.
10. *Argentino—Mayo*. The beds are much disturbed and probably faulted on the slopes of the range toward Blue River valley, and the horizons have not been determined with certainty. The sandstones on the lower slopes probably belong to the Dakota, and the black clays higher up may be Colorado.
11. *Breckenridge—Dickey*. Road follows valley of Blue River. Rich gold placers have been washed in this and tributary valleys.
12. *Curtain—Birds Eye*. On the east side of the narrow valley of Ten Mile Creek which the R. R. ascends, the steep slopes of the Mosquito Range furnish excellent exposures of Archean rocks. White veins of pegmatite and dark bands of hornblende schists stand out prominently in the generally light-colored mass of granite-gneiss. About three miles above Wheeler the R. R. crosses the Mosquito fault, and passes from Archean into Upper Carboniferous and intrusive porphyry.
13. *Alicante*. The Mosquito fault crosses the Arkansas valley in a north and south direction about tangent to the curve or loop of the railroad. By its displacement the Archean rocks forming the high mountains to the east have been lifted up and brought into juxtaposition with Upper Carboniferous and Triassic strata on the west.
14. *Leadville*. Silver mines in Carboniferous limestone. Gold placers in gulches.
15. *Fairplay*. Quaternary gravels which have been washed for gold.
16. *Piatte River*. Salt Springs and gypsum deposits west of here.
17. *Nathrop*. Ridge east of station, rhyolite carrying topaz.
18. *Pitkin*. Ridge of Paleozoic limestones to the northwest.
19. *Louisville*. Fault in R. R. cut one half mile south. In opposition are seen the coal s.s. at base of Laramie, and the shales and iron-stones above the sandstone.
20. *Balston*. Basalt breaking through the Cretaceous formations in hill to the west.
21. *Golden*. Table topped ridges to south and east formed of Denver Tertiary beds, capped and protected from erosion by flow of basaltic lava. Hogback ridges of Dakota sandstone, carrying fire clay to the west. Coal mines in vertical beds of Laramie sandstone. See 22.
22. The road crosses vertical outcrop of Laramie and Dakota Cretaceous and of Triassic Red beds before entering the Archean. Excellent fire clay found in the Dakota, north of Golden.
23. Granite, granite-gneiss and schists.
24. Gold mines in granite-gneiss often associated with porphyry dikes. Main ore is auriferous pyrites. Treated in amalgamating mills.
25. *Georgetown*. Silver mines mainly in granite-gneiss and intrusive porphyry. Main ore argentiferous galena, pyrite and sulphides of silver. Ore mostly treated in smelting works, after being dressed and concentrated here.

Union Pacific Railway.			Denver and Rio Grande Railway.		
Ma. Denver, Marshall and Boulder Branch. Alt.			Ma. Denver and Leadville Line.—Con: Alt.		
For distances see Col. C. Br., Bld G'ge.	Denver.	{ 20. Quaternary over Denver Tertiary.	120 Pueblo. ⁴⁷	18 b. Colorado.	4669
	Argo. ³⁶	20. Quaternary.	124 Goodnight.	{ 18 b. Colorado Cretaceous.	4700
	Argo Junction.	"	180 Meadow. ⁴⁸	"	4790
	Semper.	"	185 Swallow.	"	
	C. C. Junction.	"	140 Carlisle.	"	
	Louisville. ³⁹	18 d. Laramie.	148 Beaver. ⁴⁹	"	
	Boulder.	18 c. Fox Hills. 5303	144 Thompson.	"	
	Ni Wot.	18 b. Colorado.	153 Florence. ⁵⁰	"	
	Longmont. ¹¹⁹	"	157 Reno. ⁵¹	18 c. Fox Hills.	
	Highland.	"	161 Cañon City. ⁵²	{ 18 b. Colorado Limestone.	5323
	Berthoud.	"	162 Cañon Junction.	1. Archæan.	5311
	Loveland.	"	165 Gorge. ⁵³	"	
	Fort Collins.	18 c. Fox Hills.			
Denver and Rio Grande Railway. Denver and Leadville Line.			171 Parkdale. ⁵⁴	{ 17. and 18 a. Jur. and Dakota Cretaceous.	5715
0 Denver.	{ 20. Quaternary over Denver Tertiary	5175	176 Spike Buck. ⁵⁵	1. Archæan.	
2 Burnham.	"		186 Texas Creek. ⁵⁶	1. Gneiss.	6100
4 N. O. Crossing.	"		193 Cotopaxie. ⁵⁷	1. Red Granite.	6264
8 Petersburg.	"		199 Vallio.	{ 20. Quaternary and Tertiary beds over Archæan.	6513
11 Littleton.	" 5380		205 Howards. ⁵⁸	{ 20. Quaternary over Archæan.	6693
17 Acequia. ⁵⁷	{ 19. Monument Creek Tertiary.	5503	207 Badger. ⁵⁹	{ 14 a. Upper Carboniferous.	6743
25 Sedalia. ⁶⁰	"		215 Cleora.	{ 20. Quaternary over Archæan.	6993
29 Plateau.	"		217 Salida. ⁶⁰	"	7023
33 Castle Rock. ⁶⁰	" 6103		224 Brown's Cañon.	"	
35 Douglas.	"		225 Harp.	1. Archæan.	
39 Glade. ⁶⁰	" 6515		226 Hecla Junction.	"	
43 Larkspur.	" 6649		234 Nathrop. ⁶¹	{ 20. Quaternary over Archæan.	7073
47 Greenland. ⁶¹	" 6899		239 Midway.	1. Archæan.	7300
52 Palmer Lake. ⁶²	"		242 Buena Vista. ⁶²	{ 20. Quaternary over Archæan.	7943
56 Monument.	" 6953		248 Dornick.	"	
58 Borst's.	" 6811		246 Americus.	" 8113	
62 Husted's. ⁶³	"		250 Riverside.	{ 1. Archæan Granite.	8350
67 Edgerton.	"		255 Pine Creek.	"	8783
71 Pike View. ⁶⁴	"		259 Granite. ⁶³	"	8923
75 Colorado Springs. ⁶⁵	{ 18 d. Laramie 5970		261 Twin Lakes.	" 9005	
	{ 20. Valley Quaternary over Colorado Cretaceous.	5697	265 Hayden.	{ 20. Arkansas Valley Quaternary.	9136
84 Widefield.	" 5503		270 Crystal Lake.	"	9359
89 Fountain.	" 5846		273 Malta.	" 9553	
94 Butte. ⁶⁶	" 5016		274 Eilers. ⁶⁴	20. Quaternary.	9586
96 Wigwam.	"		277 Leadville. ⁶⁴	"	10176
106 Pinon.	"				
112 Cactus.	"				

26. *Graymont.* Ascent of Gray's Peak easily made in a few hours.

27. *Big Springs—La Salle.* The railroad follows the bottom of the South Platte River. The country adjoining is formed of Upper Cretaceous beds overlaid on the north by Miocene Tertiary.

28. *Platteville—Denver.* The plain country traversed is underlaid by Laramie Cretaceous covered by quaternary gravels and loess, and in some parts by remnants of Denver Tertiary.

29. *Platteville.* Directly west is Long's Peak (14,271 ft.), at the southern end of the beautiful valley of Estes Park; it is the highest and finest mountain in this portion of Colorado.

30. *Coal mines.*

Denver and Rio Grande Railway. Denver and Ogden Line.			Denver and Rio Grande Railway. Denver and Ogden Line—Con.		
Ms.		Alt.	Ms.		Alt.
217	Salida. ⁶⁰	{ 20. Quaternary ⁷⁰²³ over Archæan.	364	Colorow. ⁷⁹	20. Quaternary.
221	Poncha Junct. ⁶⁵	{ 19. Tertiary ⁷⁴⁸³ Lake beds.	374	Delta.	" 4947
226	Otto. ⁶⁶	1. Archæan.	376	Escalante.	" 4814
228	Mears Junction.	Andesite.	392	Dominguez.	" 4771
230	Shirley.	" ⁸⁶⁸⁴	399	Bridgeport.	" 4727
235	Gray's. ⁶⁷	1. Archæan Granite.	409	Kahnab.	" 4649
242	Marshall's. ⁶⁸	Andesite.	412	White Water.	" 4838
245	Hillden.	1. Gneiss.	425	Grand Junct.	" 4861
246	Shamans. ⁶⁹	"	438	Roan. ⁸⁰	" 4809
250	Chester.	Eruptive Rocks.	439	Fruitvale.	"
254	Buxton.	"	446	Crevasse.	"
259	Sargent.	1. Archæan. ⁸⁴⁸⁸	452	Shale.	" 4578
264	Elks.	"	457	Excelsior.	" 4895
267	Crookton.	Eruptive Rocks.	463	Acheron. ⁷⁹	"
271	Doyle.	" ⁸⁰⁸⁵	474	West Water. ¹²¹	"
272	Bonita. ⁷⁰	"	479	Cottonwood.	"
278	Parlin. ⁷¹	1. Archæan. ⁷⁹²³	Continued in Utah.		
284	Mounds.	"	Denver and Silverton Line.		
290	Gunnison. ⁷²	20. Quaternary. ⁷⁶⁵⁸	121	Bessemer. ⁸¹	18 b. Colorado. ⁴⁷⁸¹
296	Ridgeway.	1. Archæan.	129	San Carlos.	" ⁴⁹¹²
302	Kezar.	" ⁷⁴⁰⁹	134	Greenhorn.	" ⁵⁰⁷⁶
309	Cebolla. ⁷³	" ⁷²³⁰	141	Salt Creek.	" ⁵⁴⁴²
316	Sapinero. ⁷⁴	" ⁷²²³	147	Granero's.	"
322	Curecante.	" ⁷⁰⁸²	151	Huerfano.	" ⁵⁶⁵⁷
329	Crystal Creek. ⁷⁵	" ⁶⁸⁶⁹	164	Apache.	" ⁵⁹¹⁷
331	Cimarron. ⁷⁶	{ Fox Hills ⁶⁸⁷⁴ Sandstone.	176	Walsen's. ⁸⁰	18 d. Laramie. ⁶¹⁶⁷
336	Cerro Summit. ⁷⁷	"	181	Wahatoya.	18 a. Dakota. ⁶⁴⁸²
343	Cedar Creek.	{ 18 b. Colorado ⁶⁷²⁸ Clays.	191	La Veta.	{ 14. Carbonifer- ous Beds. ⁷⁰⁰²
353	Montrose. ⁷⁸	" ⁵⁷⁷¹	199	Ojo.	" ⁸¹⁶⁷
			202	Mule Shoe. ⁸²	" ⁸⁷⁸²
			206	Veta Pass. ⁸³	"

31. *Morrison*. Remains of *Atlantosaurus* found in Jura—Trias (red beds) just above town resting on Archæan Gypsum deposits.
32. *Stout*. Gypsum deposits found in Triassic rocks.
33. Numerous dikes of porphyry and diorite traversing the granite and schists. Mines of gold and silver. In the former a most interesting series of telluride minerals.
34. *Arapahoe—Magnolia*. The outlines of the formations on this plain area are still somewhat uncertain; they are undoubtedly Cretaceous, however, with a varying cover of Quaternary.
35. Underlaid by Denver Tertiary.
36. *Argo*. Large smelting works using the Augustine Ziervogel process for the separation of silver from copper.
37. *Acequia*. High line canal crosses Plum Creek.
38. *Sedalia*. Wild Cat Buttes to the west show folding of Monument Creek beds. Plateau capped by Monument Creek Tertiary.
39. *Castle Rock*. Table topped hills to the east, capped by pink rhyolitic tufa, extensively used as building stone in Denver.
40. *Glade*. Dawson's Butte to west.
41. *Greenland*. White knoll of Tertiary to west, known as Casa Blanca.
42. *Palmer Lake*. Tertiary covers upturned edges of Mesozoic and Palæozoic strata and abuts against Archæan foot-hills.
43. *Hustedes*. In the distance to the west are some tall monuments, characteristic of the formation.
44. *Pike View*. On the line between Monument Creek and Laramie formations.
45. *Colorado Springs*. Fine view of Pike's Peak. Manitou, a summer resort where the actual springs are situated, lies four miles west, in a recess at the foot of the mountains.
46. *Butte*. Road follows the bottom of the Fontaine-qui-bouille, or Fountain Creek, named by the Canadian trappers from the effervescent springs at its source.
47. *Pueblo*. Niobrara limestone carrying casts of *Inoceramus* in railroad cut north of town.
48. *Meadow*. Bluffs capped by limestone.
49. *Beaver*. Prominent outcrops of Niobrara limestone along Bluffs on either side of railroad.
50. *Florence*. Oil Wells. Branch to Canon City coal fields to bluffs.
51. *Reno*. Laramie beds capping cliffs to north.
52. *Canon City*. Road crosses upturned edges of Dakota sandstone, Jura and Trias—latter capped by later horizontal beds. Effervescent spring in Dakota hog back north of road, and *Hot Spring* on south near contact of Archæan.

Denver and Rio Grande Railway.			Denver and Rio Grande Railway.		
Ms.	Denver and Silverton Line.—Con.	Alt.	Ms.	Denver and Silverton Line.—Con.	Alt.
208	Blanca. ⁸⁴	{ 14. Carboniferous Beds.	394	Carracas. ⁹⁴	{ 18 c. Fox Hills. 6151
213	Placer. ⁸⁵	20. Quaternary. 8388			{ 19. Tertiary 5991
219	Trinchera. ⁸⁶	{ 20. Quaternary 8082 over Archæan.	402	Arboles. ⁹⁵	{ Sandstones and Shales.
226	Garland.	" 7914	405	Siding No. 22. ⁹⁶	" 6200
		20. Alluvial 7592	409	Vallego.	" 6253
238	Baldy.	{ deposits in the San Luis Valley.	412	Solidad.	" 6210
247	Hayes.	" 7824	415	Serape.	" 6210
250	Alamosa.	" 7827	417	La Boca. ⁹⁷	20. Quaternary.
265	La Jara.	" 7866	424	Ignacio.	{ 19. Tertiary 6415
279	Artonito. ⁸⁷	{ 20. Quaternary 7866 Gravels.			{ Sandstones and Shales.
289	Lava.	" 8446	430	Silla.	" 6659
		Basaltic 9000	433	Colina.	" 6712
298	Big Horn.	{ Tufa.	436	Florida.	18 d. Laramie. 6895
		Andesitic 9215	444	Bocea.	Fox Hills.
308	Sublette.	{ Creceia.	447	Carbon. ⁹⁸	"
309	Toltec. ⁸⁸	" 9448	450	Durango. ⁹⁹	{ 18 b. Colorado 6493
317	Osier.	" 9615			{ Clays.
321	Los Pinos.	" 9615	452	Animas. ⁹⁹	{ 18 d. Dakota 6522
329	Cumbres.	" 9998			{ Sandstones.
331	Coxo.	" 9781	457	Home Ranch.	{ 14 c. Upper Car- boniferous.
334	Cresco.	"	459	Trimble. ¹⁰⁰	"
338	Lobato.	"	461	Hermosa. ⁹⁹	14 b. Weber Grita. 6622
343	Chama.	" 7841	468	Rockwood. ¹⁰¹	{ 1. Archæan Red Granite.
348	Willow Creek.	" 7720			{ 1. Granite Gneiss and Schists. 7768
352	Azotea.	" 7701	477	Cascade.	" 8118
362	Monero. ⁸⁹	18 c. Fox Hills. 7256	481	Needleton.	" 8761
365	Amargo. ⁹⁰	" 6987	489	Elk Park. ¹⁰²	{ 20. Quaternary 9203
372	Dulce. ⁹¹	" 6757	495	Silverton.	{ Valley.
376	Navajo. ⁹²	" 6866			
385	Juanita. ⁹³	" 6819			

53. *Gorge*. The Archæan in the Royal Gorge consists of gneiss and schists with intrusive masses of red granite and small dikes of diabase.

54. *Parkdale*. This valley was one of the ancient bays in the original Archæan sand mass.

55. Gneiss and amphibolite traversed by red granite.

56. *Texas Creek*. At head of valley to north are horizontal beds of eruptive rocks (andesite?).

57. *Cotopaxi*. Eruptive rock on high hill to north. Carboniferous to the south of Vallico.

58. *Howards*. High peaks of the Sangre de Christo range to the south.

59. *Badger*. A continuous descending series of upturned Palæozoic beds, somewhat faulted, and resting on Archæan is crossed from here to Cleora.

60. *Salida*. Tertiary beds on west side of valley. Andesite hills east of town.

61. *Northrop*. Ridges of Rhyolite just above station. Rock carries Crystals of garnet and topaz.

62. *Buena Vista*. Fine view of the high peaks of the Sawatch Range. Mt. Harvard (14,375 ft.) the northernmost, then Mt. Yale (14,187); to south of west, Mts. Princeton (14,196), Mt. Antero (14,246), and Mt. Shavano (14,239).

63. *Granite*. On the west side of the valley are many important gold placers. Twin Lakes, beautiful sheets of water held by terminal moraines, at the north of Lake Creek, a few miles west of railroad. (Good mountain hotel, trout fishing, etc.) Remarkably well defined moraines on either side of lakes.

64. *Elora—Leadville*. Road rises from Arkansas valley over mesa of lake beds covered by re-arranged moraine material. Above Leadville are argentiferous lead deposits in Carboniferous limestone.

65. *Poncha Junction*. Line of Archæan opposite Spring hotel.

66. *Otto*. Some Andesite on the east side.

67. *Gray's*. Andesite at mile post 237.

68. *Marshall's*. Hills around are largely Archæan.

69. *Shaman's*. Eruptive on the south and at sign of station.

70. *Bonita*. At Bonita are Cretaceous rocks resting on Archæan—eroded. At 273.5 to 274.5 an eroded anticlinal gives a wider outcrop to the Archæan.

71. *Parlin*. Cretaceous on hills to north. Probably eruptives to south capped by Cretaceous beds and eruptives.

72. *Gunnison*. Eruptive cliffs (Andesite) on west and northwest.

Denver and Rio Grande Railway.			Denver and Rio Grande Railway.		
Ms.	Manitou Branch.	Alt.	Ms.	Monarch Branch.	Alt.
75	Colorado Spr'gs.	18 d. Laramie. 5970	217	Salida. ⁶⁰	20. Quaternary. 7028
78	Colorado City.	18. Colorado. 6092	221	Poncha.	" 7458
81	Manitou. ¹⁹⁸	{ 14. Carboniferous Limestones. 6302	228	Maysville.	{ 19. Tertiary Lake Beds. 8298
Silver Cliff Branch.			235	Garfield. ¹¹¹	1. Archæan
			238	Monarch.	"
			Eagle River Branch.		
161	Cañon City.	{ 18 a. & b. Col. 5323	277	Leadville.	{ 20. Quaternary Lake Beds. 9558
163	Cañon Junct.	{ orado Limestone & Dakota Sandstone. 1. Archæan. 6325	273	Malta.	{ 20. Arkansas Valley Quaternary. 9948
172	Marsh. ¹⁰⁴	" 6325	279	Keildar.	" 10097
177	Soda Springs.	" 6325	282	Crane's Park. ¹¹³	{ 1. Archæan Granite. 10097
194	West Cliff. ¹⁰⁵	{ 20. Quaternary over Archæan. 7843	283	Tennessee Pass.	"
San Luis Branch.			294	Eagle Park. ¹¹⁸	{ 20. Quaternary Valley Bottom. 9449
217	Salida.	20. Quaternary. 7028	300	Red Cliff. ¹¹⁴	{ 2 b. Cambrian Quartzite. 9449
228	Mears Junct.	Andesite. 8417	Blue River Branch.		
281	Poncha Pass.	1. Archæan. 8945	277	Leadville.	{ 20. Quaternary Lake Beds. 10178
247	Villa Grove.	{ 20. Quaternary of San Luis Valley. 7725	282	Birds Eye.	14 b. & Porphyry. 10167
255	Hot Springs. ¹⁰⁶	{ 14. Carboniferous(?) Limestone.	290	Fremont Pass. ¹¹⁵	14 b. Weber Grits.
Crested Butte Branch.			294	Robinson.	14 c. & Porphyry. 10849
217	Salida.	{ 20. Quaternary over Archæan. 7028	296	Kokomo.	14 c. & Porphyry. 10809
290	Gunnison. ⁷⁸	" 7658	302	Wheelers.	{ 20. Quaternary over Archæan. 9759
301	Almont. ¹⁰⁷	1. Archæan.	309	Frisco.	" 9064
812	Jack's Cabin.	18 c. Fox Hills. 8284	318	Dillon.	" 8853
818	Crested Butte. ¹⁰⁸	18 c. Laramie. 8853	El Moro Branch.		
Del Norte Branch. ¹⁰⁹			120	Pueblo.	18 b. Colorado. 4669
250	Alamosa.	20. Quaternary 7524	170	Cuchara.	" 5921
268	Henry.	" 7853	180	Santa Clara.	" 6137
281	Del Norte.	" 8166	190	Apishapa.	" 6095
297	South Park. ¹¹⁰	" 8427	199	Chicosa.	" 5857
811	Wagon Wheel Gap.	{ Eruptive Cliffs.	206	El Moro. ¹¹⁶	18 d. Laramie.

73. *Cebolla*. Large deposits of magnetite occur in the valley of Cebollo Creek. Capping of Cretaceous sandstone and andesite to north.

74. *Sapinero*. Archæan capped by Cretaceous and eruptive rocks. Cliffs of granite and gneiss.

75. *Crystal Creek*. Archæan capped by Dakota sandstone.

76. *Olmaron*. At contact of Archæan fault line.

77. *Corro Summit*. Archæan traversed by eruptive dike to north.

78. *Montross*. Stage line from here south to Ouray (35 ms.), which is beautifully situated in an amphitheatre at the head of the Uncompaghre, almost entirely surrounded by high peaks of the San Juan Mountains. Panoramic view of these mountains seen from higher points on the railroad.

79. *Colerus—Acheron*. Road follows in general valley bottom, ridges around formed of Cretaceous beds, sometimes capped by lavas.

80. *Roan*. Roan or Book Cliffs to the north.

81. *Bessemer*. Steel works of Colorado Coal and Iron Company.

82. *Mule Sho*. Spanish Peaks to south, porphyry breaking through Carboniferous strata.

83. *Veta Pass*. Red sandstone shales.

84. *Blanca*. Gray sandstones.

85. Quaternary rests on Carboniferous strata. Archæan exposed on railroad cut below. Magnetite mines five miles north of station.

86. *Trinchera*. Blanca Peak to the south is the highest peak in Colorado, (14,464 ft.)

87. Mainly the debris of eruptive rocks, basalt and andesite.

88. *Toltec*. Toltec gorge is cut through Archæan rocks which underlie the eruptives.

89. *Monero*. Coal mines in sandstones.

90. *Amargo*. Stage to Pagosa Springs (Hot Sulphur), beautiful natural pools in a bend of the San Juan river, formerly held in high repute among the Indians for their curative powers.

91. *Dules*. Narrow vertical dikes of basalt, crossing sandstone strata and standing out like stone walls on the surface.

Burlington and Missouri River Railroad.			Denver, Texas and Gulf Railroad.		
Ma.		Alt.	Ma.	Formerly Denver & New Orleans.	Alt.
400	Eckley.	20. Quaternary.	3379		
489	Akron.	"	4686	Denver.	20. Quaternary over Denver Tertiary.
452	Pinneo.	"			19. Monument Creek Tertiary.
463	Brush. ¹¹⁷	"	4235	4 Melvin.	
472	Fort Morgan.	"	4800	23 Parkers.	"
487	Corona.	"	4847	30 Bellevue.	"
504	Roggen.	"		39 Elizabeth.	"
521	Hudsen.	"	4993	47 Cameron.	"
544	Derby.	20. Quaternary over Denver Tertiary.	5159	52 Elbert.	"
551	Denver.	"	5175	58 Sidney.	"
Denver, Utah and Pacific Railroad. 113				64 Easton.	"
Narrow Gauge.				72 Granger.	"
0	Denver.	20. Quaternary over Denver Tertiary.		78 Bierstadt.	"
1	Argo.	"		81 Manitou Junc.	" 6303
17	Baker.	18 d. Laramie.		90 Colorado Sp'gs.	18 d. 5970
21	Erie.	"		87 Franceville Juc.	18 d. Laramie.
23	Mitchell.	"		94 Fountain.	As on D. & R. G. 5503
84	Longmont. ¹¹⁹	18 b. Colorado.		99 Little Buttes.	" 5346
45	Lyons. ¹²⁰	16. Trias.		105 Wigwam.	" 5211
				112 Pinon.	" 5016
				118 Cactus.	" 4859
				112 Pueblo.	" 4669

92. *Navajo*. Quarry of building stone used in new capitol at Denver.

93. *Juanita*. Junction of San Juan River.

94. *Carracas*. Cretaceous rocks dip down to west and are succeeded horizontal.

95. *Arboles*. Tertiary beds.

96. *Siding No. 22*. Junction of Piedra River.

97. *La Boca*. Valley of Los Pinos River.

98. *Durango*. Coal mines and smelting works. Colorado Cretaceous clays, capped by Fox Hill sandstones.

99. From Animas to Hermosa the cliffs on either side of the valley show an excellent section from the Cretaceous down to the Middle Carboniferous.

100. *Trimble*. Thermal bath establishment.

101. *Rockwood*. In the gorge of the Animas river is some of the boldest Alpine scenery in the Rocky Mountains. Especially fine are the Needle peaks to the east.

102. *Elk Park*. At entrance to gorge below are Cambrian quartzites and Silurian limestones resting on Archean. Mountains around capped by great thickness of andesitic Breccia, often highly altered and mineralized.

103. *Manitou*. Good section of Carboniferous and Silurian limestones and Cambrian quartzites resting on Archean seen in Williams Cañon. Cave is in Silurian limestone. Ute Falls are in the Archean just below the Paleozoic beds. In Glen Eyrie the red sandstone (Trias), by faulting or non-conformity, comes in contact with the Cambrian quartzite which rests directly on the Archean. Garden of the Gods—Trias.

104. *Marsh*. Some dark eruptive dikes seen traversing the Archean schists.

105. Flat hills of Rhyolite at Silver Cliff.

106. Brown hematite mines of the Colorado Coal and Iron Co.

107. *Almont*. Archean capped by Sandstones of Jura and Dakota Cretaceous.

108. *Crested Butte*. Mines of bituminous coal in hills southwest of town. Anthracite on either side State Creek valley.

109. Road follows alluvial deposits of Rio Grande river.

110. *Wagon Wheel Gap*. Andesitic breccia.

111. *Garfield*. Archean on west, Carboniferous and Silurian on east.

112. *Crane's Park*. Cambrian quartzite resting on Archean.

113. *Eagle Park*. Valley cut partly in Archean, partly in overlying Paleozoic rocks.

114. *Red Cliff*. Archean cut just below town. On either side cliffs of Cambrian, Silurian and Carboniferous beds.

115. *Fremont Pass*. Archean forms mountains east of Mosquito fault.

116. *El Moro*. Coal mines and coke ovens.

117. Plains country underlain by Cretaceous beds, either Laramie or Fox Hills.

118. Distances and stations on this line given approximately.

119. *Longmont*. Red sandstone quarries. Flagging and building stone.

120. *Lyons*. Stage starts from here for Estes Park, twenty-two miles.

121. *Sierra La Sal*. High isolated peak to south.

Wyoming, Utah, Nevada and Idaho.*

LIST OF GEOLOGICAL FORMATIONS IN THESE TERRITORIES,

In the region of the Union Pacific and Central Pacific Railroads.

GENERAL TABLE.	WYOMING.	UTAH.	NEVADA.
20. QUATERNARY.	20. Quaternary.	20. Up. Quatern'y. 20. Lower Quat'y.	20. Up. Quatern'y.
19 c. PLIOCENE.		19 c. Humboldt.	19 c. Humboldt.
19 b. MIOCENE.	19 c. Niobrara.		19 b. Truckee.
19 a. EOCENE.	19 b. White River.	19 a. Bridger.	
"	19 a. Bridger.	19 a. Green River.	19 a. Green River.
"	19 a. Green River.	19 a. Vermill'n Ck.	
"	19 a. Vermill'n Ck.		
18. CRETACEOUS.	18 d. Laramie.	18 d. Laramie.	No Cre- taceous in Nevada.
"	18 c. Fox Hill.	18 c. Fox Hill.	
"	18 b. Colorado.	18 b. Colorado.	
"	18 a. Dakota.	18 a. Dakota.	
17. JURASSIC.	17. Jurassic.	17. Jurassic.	17. Jurassic.
16. TRIASSIC.	16. Red Beds.	16. Red Beds.	16. Star Peak.
"			16. Kaipato.
14. CARBONIFEROUS.		14-15. Perm. Carb.	
"		14 c. Up. Cl. Mres.	14 c. Up. Cl. Mres.
"	14 Coal Measures.	14 b. Weber Quart.	14 b. Weber Quart.
"		14 a. Low. Cl. Mres.	14 a. Low. Cl. Mres.
13. SUB-CARBONIF'S.		13. Sub-Carbonif's.	13. Sub-Carbonif's.
"			Diamond Pk. Quart.
9-11. DEVONIAN.		9-11 Nevada l. s. Ogden Quartzite.	9-11. White Pine Sh'le. Nevada Limestone.
5-7. SILURIAN.		5-7. Ute Limestone.	5-7 Lone Mt. l. s. Eureka Quartzite. Pogonip Limestone.
"			
"			
2-4. CAMBRIAN.		2-4. Cambrian.	2-4. Hamburg Shale. Hamb'rg Limestone. Secret Canon Sh'le. Prospect Mt. l. s. " " Quart.
"			
"			
"			
1. ARCHÆAN.	1 b. Huronian. 1 a. Laurentian.	1 b. Huronian. 1 a. Laurentian.	1. Archæan.

*The Table of Formations and the main line of the Union and Central Pacific Railroads, the Utah and Northern Division, the Eureka and Palisade, and Virginia and Truckee Railroads are by Mr. Arnold Hague, Geologist, United States Geological Survey. Mr. G. K. Gilbert, U. S. Geologist, furnishes the lines in Utah and Mr. John B. Hastings, M. E., of Ketchum, Idaho, and Prof. G. E. Bailey of Rapid City, S. Dakota, have noted the lines given under their authority.

Wyoming.			Utah.		
Ms.	Union Pacific Railroad.	Alt.	Ms.	Union Pacific Railroad. Continued.	Alt.
463	Bushnell, Neb.	19 c. Niobrara, Pliocene.	957	Evanston. ¹³	19 a. Ver'n Ck. 5788
473	Pine Bluffs, Wy.	" 5047	968	Wasatch. ¹⁴	" 5833
484	Egbert.	"	977	Castle Rock.	" 5249
496	Hillsdale.	"	993	Echo.	" 5480
508	Archer.	"	1009	Weber. ¹⁵	14 b. Lr. C'l Ms. 5090
516	Cheyenne. ¹	" 6059	1021	Devil's Gate. ¹⁶	1. Archæan.
523	Hazard.	"	1026	Uinta. ¹⁷	20. Quaternary. 4519
531	Otto.	"	1032	Ogden. ²⁰	" 4303
536	Granite Cañon. ²	1 a. Lauren'n. 7319	Central Pacific Railroad.		
542	Buford.	" 7785	0	Ogden. ²⁰	20. Quaternary. 4303
549	Sherman. ³	" 8256	10	Bonneville.	" 4310
559	Harney.	"	24	Corinne.	" 4332
564	Red Buttes. ⁷³⁰⁹	17 Jurassic & Trias.	43	Blue Creek.	14 a. Lr. C'l Ms. 4379
570	Fort Sanders.	18 a. Dak., Cretace's.	53	Promontory.	" 4905
573	Laramie City.	" 7158	78	Monument Pt.	20. Quaternary. 4327
581	Howell.	" 7090	94	Kelton.	" 4223
589	Wyoming. ⁷⁰⁸⁶	18 b. Colo., Cretac's.	113	Matlin. ¹⁸	Basalt. 4597
599	Cooper's Lake.	" 7078	124	Terrace.	20. Quaternary. 4544
608	Lookout.	" 7177	134	Bovine.	" 4347
616	Miser.	"	147	Lucin.	" 4498
625	Rock Creek.	"	Nevada.		
640	Aurora. ⁴	17 Jurassic.	Central Pacific Railroad.—Continued.		
648	Medicine Bow.	18 b. Colo., Cret. 6571	167	Montello.	20. Quaternary. 5010
657	Carbon. ⁵ 6830	18 d. Laramie, Cret.	183	Toano.	19 c. Humb't. 5973
668	Percy. ⁶	" 6971	193	Pegu.	" 6184
682	Edson.	"	195	Otego.	19 a. Green R. E'cene.
690	Walcott's. 6800	18 c. Fox Hill, Cret.	205	Independence.	20. Quaternary. 6007
696	Fort Steele.	"	210	Moors.	14 c. Upper C'l Ms.
711	Rawlins. ⁷ 6753	14 b. Coal Measures.	220	Wells. ¹⁹	20. Quaternary. 5629
724	Separation.	18 d. Laramie, Cret.	227	Tulasco.	" 5418
739	Creston.	" 7048	252	Halleck.	" 5230
754	Wash-a-kie.	19 a. Ver'n Ck.	257	Peko.	" 5204
764	Red Desert.	" 6722	266	Osino. ²⁰	" 5100
779	Table Rock.	" 7551	275	Elko. ²¹	" 5063
787	Bitter Creek.	" 6705	287	Moleen. ²²	" 4982
791	Black Buttes.	18 d. Laramie, Cret.	299	Carlin.	" 4897
801	Hallville.	" 6890	308	Palisade. ²³	Rhyolite. 4831
807	Pt. of Rocks. ⁸	" 6517	326	Be-o-wa-we.	20. Quaternary. 4695
818	Salt Wells.	20. Quaternary. 6381	336	Shoshone.	" 4638
826	Baxter. ⁹ 6300	18 d. Laramie, Cret.	347	Argenta.	" 4511
832	Rock Springs. ¹⁰	" 6270	360	Battle Mount'n.	"
847	Green River. ¹¹	19 a. Green R. 6083	379	Stone House.	4422 " [of stat'n.
860	Bryan. 6196	19 a. Bridger, Eocene.	394	Iron Point. 4375	16. Trias., to the west
878	Granger.	" 6289	403	Golconda.	Rhyolite. 4385
888	Ch'reh Buttes. ¹²	" 6363			
905	Carter.	"			
915	Bridger. 6637	19 a. Ver'n Ck. E'ne.			
930	Piedmont. 7082	19 a. Green Riv. E'ne.			
939	Aspen. 7405	18 c. Fox Hill, Cret.			

1. At Chalk Bluffs, 15 miles southeast from Cheyenne, the Niobrara Pliocene and White River Miocene are both exposed, the latter resting unconformably upon the beds of the Laramie Cretaceous.

2. Both to the north and south of Granite Cañon the Paleozoic beds may be seen resting against the Archæan rocks.

3. Sherman, the highest station along the line of the Union Pacific Railroad, lies 8,256 feet above sea-level, and is on the summit of the Colorado range.

4. The railroad passes through the axis of an anticlinal fold, exposing an excellent section of Jurassic strata.

Central Pacific Railroad.			Utah.		
Ms.	Continued.	Alt.	Ms.	Union Pacific Railroad.—Continued. Utah and Northern Division. ^{§1}	Alt.
414 Tule.	19 c. Humb't, Pliocene.		0 Ogden. ⁴⁵	20. Quaternary.	4308
419 Winnemucca.	"	4332	9 Hot Springs.	"	4277
430 Rose Creek.	"	4322	14 Willard.	"	4340
440 Raspberry.	"	4327	22 Brigham.	"	4315
448 Mill City. ²⁴	4226 " [side.		32 Honeyville.	"	4276
459 Humboldt. ²⁵	16. Triassic, on the east		34 Dewy.	"	4320
471 Rye Patch.	"	4257	41 Collinston.	"	4691
481 Oreana.	19 c. Humb't, Pliocene.		51 Mendon.	4450 19 c. Humb't Pliocene.	
483 Humbolt Bridge.	"		58 Logan.	"	4499
493 Lovelocks.	"	3977	63 Hyde Park.	"	
502 Granite Point.	20. Quatern'y. [stat'n.		65 Smithfield.	"	4555
509 Brown's. ²⁶	Rhyolite west of the		71 Richmond.	"	4527
521 White Plains.	"	3894	78 Franklin.	"	4505
528 Mirage	19 b. Truckee, Mi'c'ne.		Idaho.		
535 Hot Springs. ²⁷	Basalt on E. side. ⁴⁰⁷²		Union Pacific Railroad.—Continued. Utah and Northern Division. ^{§1}		
546 Desert.	Basalt on west side.		90 Battle Creek.	20. Quaternary and 19. Pliocene.	4492
555 Wadsworth. ²⁸	20. Quaternary.	4077	101 Oxford.		4768
569 Clark's.	Rhyolite, Andesite.		115 Calvin.		
581 Vista.	20. Quaternary.	4400	125 Arimo.		4654
589 Reno.	"	4497			
600 Verdi.	"	4595			
616 Boca, Cal.	"	5531			
(Continued in California.)					

5. Carbon offers an excellent opportunity for studying the Cretaceous coals of Wyoming.
6. To the south of Percy Station, Elk Mountain, which rises conspicuously above the plain, consists of Archaean crystalline schists, with Palaeozoic and Mesozoic strata upon the slopes.
7. Rawling's Peak consists of an Archaean mass, surrounded by Palaeozoic and Mesozoic beds. In the coal measures is an interesting body of iron ore.
8. Northeast from Point of Rocks is a remarkable outburst of leucite rocks.
9. There is exposed here an interesting section of Laramie coal rocks.
10. Near Rock Springs the coal formations are well shown.
11. Along the bluffs of Green River are seen the best exposures of the Green River Eocene. These beds are celebrated for the fine specimens of fossil fishes preserved in the shales.
12. On the south of the railroad, between Church Buttes and Carter, may be seen distant but good views of the Uinta Range.
13. About three miles north of Evanston are situated the Rocky Mountain and Wyoming coal Company's mines, where there is a good section of the Laramie beds. These mines have supplied immense quantities of coal used by the Union and Central Pacific roads.
14. From Wahsatch to Echo the railroad passes through Echo Cañon, where are exposed both the Vermillion Creek and Laramie formations, the former lying unconformably upon the latter.
15. Passing through Weber Cañon, from Lost Creek to Weber Station, there is exposed a series of beds from the top of the Jurassic, through the Triassic, Upper Coal measures, Weber Quartzite to the base of the Lower Coal measures.
16. At the Devil's Gate the Archaean rocks of the Wahsatch Range are characteristically shown.
17. The terraces of Lake Bonneville, which stand over 950 feet above the present level of Salt Lake, may be seen from Uinta station. They may be easily traced all the way from Ogden to Lucin.
18. On the north side of the railroad at Matlin the old lake terraces are distinctly cut in basalt.
19. From Wells there is a fine view of the East Humboldt range. Mount Bonpiand attains an elevation of 11,321 feet above sea-level.
20. Just east of Osino the railroad passes through Osino Cañon, exposing a good section in the Weber Quartzite.
21. In the neighborhood of Elko may be seen the Green River Eocene, Humboldt Pliocene, characteristic outbursts of rhyolite and "Chicken Soup" hot springs.
22. In Moleen Cañon the Carboniferous formations are well shown. The limestones of Moleen Peak, just south of the railroad, carry large numbers of coal measure fossils.
23. Fallsade Cañon cuts through rhyolites. Andesites are also exposed.
24. Mill City is the most convenient place to leave the railroad in order to study the characteristic Triassic formations of the West Humboldt Range.
25. From Humboldt there is a fine view of the West Humboldt Range. In the neighborhood are some interesting outbursts of basalt and a deposit of sulphur.
26. In the Montezuma Range, west of Brown's station, the volcanic rocks are well shown. It is an interesting place to study rhyolites and basalts.
27. The Hot Springs, a short distance east of the station, reach the surface near the base of basaltic hills.
28. The Truckee Cañon, just east of Wadsworth, offers remarkable outbursts of a great variety of volcanic rocks. There may be seen here basalts, rhyolites and andesites. Tourists leave the railroad here for Pyramid Lake.
29. Propylite is the characteristic volcanic rock, which carries the Comstock Lode. A. H.
30. The last rail completing the Pacific railroads, from Omaha to San Francisco, was laid May 19, 1892.

Idaho.			Idaho.		
Union Pacific Railroad.—Continued.			Union Pacific Railroad.—Continued.		
Ms.	Utah and Northern Division. ³¹	Alt.	Ms.	Oregon Short Line. ³²	Alt.
182	McCammon.	4755	968	Border.	16-17 Jura. Trias. ⁶⁰³³
142	Inkone.		974	Nupher.	20. over " 6041
148	Port Neuf.	Cambrian in hills.	984	Dingle.	" " "
155	Pocatello.	Quat'y on basalt. 4468	991	Montpelier.	" " 5948
166	Ross Fork.	" 4452	997	Piscadero.	20. over Salt L. Ter. 5938
179	Blackfoot.	" 4503	1002	Oasis.	Salt Lake Ter. 5318
191	Basalt.	Basalt. 4579	1005	Novene.	" "
205	Eagle Rock.	" 4714	1020	Stock Yards.	Basalt.
215	Payne.	" 4781	1021	Soda Springs.	Basalt. 5792
222	Market Lake.	" 4781	1026	Crater.	Basalt. 5726
235	Hawgood.		1038	Squaw Creek.	Basalt. Clin hills. 5427
243	Camas. 4822	B's't cov. 19 c. Pl'e'ne.	1053	Lava.	Cambrian Hills.
	Dry Creek.		1060	Topaz.	Quat., Basalt. 4926
	High Bridge.		1067	McCammon.	Quaternary. 4765
	China Point.		1072	Onyx.	" 4648
272	Beaver Canon.	" 6025	1078	Inkom.	Quat. Camb. in hills.
	Pleasant Valley.	Drift and Basalt.	1090	Pocatello.	Quat. on Basalt. 4468
	Monida.	6809	1099	Michaud.	4475
	Williams.		1109	Sunshine.	
Montana.			1115	American Falls.	{ Late Ter. or Quat. Basalt. ³³ 4543
Union Pacific Railroad.—Continued.			1124	Napata.	" 4467
Utah and Northern Division. ³¹			1132	Wapi.	" "
800	Spring Hill.	6267	1148	Minidoka.	" 4287
	Dell.		1156	Oniona.	" "
323	Red Rock. 5605	Carbonifer's in Mts.	1165	Kimama.	" 4219
	Grayling.	Pal'z'c and ign's rocks.	1179	Owinza.	" 4211
	Barratts.	[and Arch. in hills.	1188	Waucanza.	" 4073
348	Dillon. 5106	19 c. Pl'e'ne, Palz. l. s.	1197	Shoshone. ³⁴	" 3975
378	Melrose.	5191	1213	Toponis.	" 3581
382	Lowell.		1226	Bliss.	" "
394	Feely.		1232	Ticeska.	" 3089
410	Silver Bow.	5344	1241	King Hill.	" 2543
417	Butte City.	Granite. 5454	1249	Glenn's Ferry.	" 2556
421	Stuart.		1261	Medbury.	" 2557
443	Deer Lodge.	4529	1269	Reverse.	" "
454	Garrison. 4340	Northern Pacific R. R.	1279	Mt. Home. ³⁵	" 3147
Wyoming.			1290	Cleft.	" "
Union Pacific Railroad.—Continued.			1298	Nameko.	" "
Oregon Short Line. ³²			1305	Bisuka.	" 3139
876	Granger. 6281	19 a. Bridg'r (Eocene.)	1312	Owyhee.	" "
891	Nutria.	" 6516	1324	Kuna.	" "
900	Waterfall.	Qu. over Wasatch. 6796	1334	Nampa. ³⁵	" 2686
918	Ham's Fork.	" 6955	1343	Caldwell.	" 2489
920	Twin Creek.	" "	1358	Parma.	" 2374
925	Fossil.	" 6665	1376	Ontario.	" "
932	Nugget.	Jura. Trias.	1378	Payette.	" "
	Sage.	Qu. over 18 d. Lar. 5532	1387	Crystal Springs.	" "
947	Beckwith.	" 6207	1391	Weiser.	" 2125
959	Cokeville. 6201	Qu. over Jura. Trias.	1407	Old's Ferry.	" "
				Oregon Line.	

31. The geology of most of the stations on the Utah and Northern Division is given by Mr. Hague, but the editor has not been able to obtain complete assignments of formations. The geology of some parts of the great West has been necessarily done in something of a reconnaissance way, and often before the railroads were located, so that accurate statements are impossible. The altitudes have been kindly furnished by Mr. Henry Garrett, Chief Geographer, U. S. Geological Survey.

Union Pacific Railroad—Continued. Oregon Short Line.—Continued. (Wood River Branch.)			Wyoming.	
Ms.		Alt.		
U Shoshone.	Quat. Basalt.	3975	Fremont, Elkhorn and Missouri Val. ³⁹ —Elkhorn	
14 Pina.	"		Ms. Valley Line.—Continued from Nebraska. Alt.	
30 Tikura. ³⁶	"	4681	509 Van Tassell.	14 c. U. C. l. to 18 a. 4727
37 Picabo.	"	4839	520 Node Ranch.	"
52 Bellevue. ³⁷ 5173	Quat. Stratified Dft.		529 Lusk.	18 b. Cret. 5007
57 Hailey. ³⁷	"	5344	538 Manville.	"
69 Ketchum. ³⁸	"	5525	545 Keeline.	18 a. and 18 c. Cret.
Wyoming.			554 Lost Spring.	18 c. Cret.
Cheyenne and Northern District. ³⁹			566 Fisher.	18 d. Cret. 4752
0 Cheyenne.	19 b. Miocene.		576 Irvine.	18 b. Cret.
4 Ft. Russell.	"		584 Douglass.	" 4810
13 Silver Crown.	Granite to 14 c.		597 Fetterman.	18 c. Cret.
17 Stone Spur.	14 c. Upp. C'l. Meas.		604 Wolcott.	18 d. Cret.
26 Islay.	" & 15 Permian.		606 Glen Rock.	"
38 Horse Creek.	16 Trias., 17. Juras.		630 Casper.	Granite. 18 c. 5118
39 Altus.	19 c. Plioc., 20. Quat.		Utah.	
46 Iron Mt.	14 a. Upp. C'l. Meas.		Denver and Rio Grande Railroad. ⁴⁰	
51 Shultz Spur.	19 b. Miocene.		Continued from Colorado.	
60 Kelley.	"		463 Acheron.	18. Lower Cretaceous.
71 Chug Water.	"		479 Cotton Wood.	" 4661
84 Bordeaux.	"		490 Cisco.	"
96 Wheatland.	"		507 Sagers.	"
103 Wendover.	"		515 Thompson's.	"
Fremont, Elkhorn and Missouri Val. ³⁹ —Elkhorn			521 Crescent.	"
Valley Line.—Continued from Nebraska.			529 Little Grand.	"
307 Valentine, Neb.	19 b. Miocene.		536 Solitude.	"
318 Crookston.	"	2670	545 Green River.	" 4988
329 Georgia.	"		558 Desert.	"
345 Cody.	"		570 Lower Crossing.	"
358 Eli.	"		591 Sunny Side.	"
370 Merriman.	"		600 Farnham.	"
383 Irwin.	"		610 Price. ⁴¹	"
397 Gordon.	"	3547	623 Castle Gate.	18. Cretaceous. 6061
412 Rushville.	"		637 Pleasant Val. Jc.	18 Upp. Cret. 7182
424 Hay Springs.	"		644 Soldier Summit.	Tertiary. 7477
433 Bordeaux.	"		658 Mill Fork.	" 5791
444 Chadron.	"	3360	669 Thistle.	18 Cretaceous. (?)
449 Dakota Jc.	"	3245	680 Spanish Fork. ⁴³	Bonneville B. Quat. 4865
459 Whitney.	"		684 Springville.	" 4566
470 Crawford.	"		689 Provo. ⁴³	" 4525
489 Andrews.	"		699 Battle Creek.	"
498 Harrison, Neb.	"		702 American Fork.	"
			705 Lehi. ⁴³	"

32. The geology from Granger to Squaw Creek is by Prof. W. B. Scott of Princeton University; thence to Michaud; it is given on the authority of an atlas of the U. S. Survey, which was made before the road was located, and the assignments must, therefore, be taken with allowance.

Geology from American Falls to the Oregon line and on the Wood River Branch is by Mr. John B. Hastings, M. E., F. G. S. A., of Ketchum, Idaho. Altitudes on all this line by Mr. Gannett.

33. These late Tertiary and Quaternary basalts form part of the great Northwestern lava-flood, of Northern California, Northwestern Nevada, Oregon, Washington, Montana and British Columbia. The basalt of the Wood River Branch is of later date than the flow from Glenn's Ferry westward.

34. *Shoshone*. Shoshone Falls of Snake River, 210 feet vertical altitude in basalt.

35. *Mountain Home, Nampa*. Gold and silver mines in Archæan granite in vicinity.

36. *Tikura*. From Tikura to Lava Creek may be seen a ropy lava field of seventy-five square miles, almost untouched by the elements, a congealed, black, stormy sea.

37. *Bellevue, Hailey, Ketchum*.—In vicinity, hot springs and argentiferous galena mines in Silurian limestone and slates and various free milling silver ores in Archæan granites. Tertiary *trachytes*.

Denver and Rio Grande Railroad.			Utah Central Railroad. ⁴⁰⁻⁴⁸		
Ms.	Continued from Colorado.	Alt.	Ms.	Continued.	Alt.
718	Draper.	Bonneville Beds. Quat.	48	Lovendahl's.	20. Quaternary. 4277
724	Bingham Jc.	" "	49	Junction.	" "
728	Germania.	" 4298	50	Sandy.	" 4299
785	Salt Lake.	" 4237	54	Draper.	" 4448
748	Wood's Crossing.	" "	68	Lehi Junction.	" 4517
750	Farmington.	" "	71	American Fork.	" 4554
754	Kaysville.	" "	74	Pleasant Grove.	" 4498
764	Hooper.	" "	85	Provo.	" 4456
771	Ogden. ⁴⁵	" "	90	Springville.	" 4451
Coal Branch.			95	Spanish Fork.	" 4498
0	Pleasant Val. Jc.	18. Upper Cretaceous.	108	Payson.	20. Bonneville Beds. 4215
14	Schofield.	" "	108	Santaquin.	20 Quaternary. 4215
19	Mud Creek.	" "	120	Mona.	" 4389
Bingham and Alta Branch.			128	Nephi.	" 5056
0	Salt Lake. ⁴⁸	Bonneville Beds. Quat.	142	Juab.	" 5019
11	Bingham Jc.	" "	151	Mills.	" 4882
27	Bingham.	14. Carboniferous.	167	Lemington.	20. Bonneville Beds. 4674
18	Sandy.	Bonneville Beds. Quat.	185	Riverside.	" 4558
21	Wasatch.	Granite.	194	Deseret.	" 4541
29	Alta.	Devonian. (?)	218	Neels.	" 4386
Utah Central Railroad. ⁴⁰⁻⁴⁸			241	Black Rock.	" 4799
0	Ogden. ⁴⁵	20. Quaternary. 4408	263	Milford.	" 4966
16	Kaysville.	" 4298	280	Frisco.	Volcanic. 6315
22	Farmington.	" 4261	Utah and Nevada Railway. ⁴⁹		
26	Centreville. ⁴⁷	" 4288	0	Salt Lake. ⁴⁸	20. Bonneville Beds.
28	Wood's Crossing.	" 4299	12	Chambers. ⁴³	14. Carboniferous.
37	Salt Lake City. ⁴⁵	" 4261	18	Garfield.	" "
43	Francklyn.	" "	20	Lake Point. ⁴³	" "
44	Germania.	" 4243	82	Tooele.	20. Bonneville Beds.
			37	Terminus.	" 4991

38. *Ketchum*. Near station at Wood River bridge hornblende-andesite. At head of Wood River valley and vicinity many gulches contain deposits of extinct glaciers, including glacial lakes with Chinook salmon and smaller salmon (*oncorhynchus norka*) locally called redfish from the color. Tertiary trachyte underlies stratified drift. J. B. H.

39. Cheyenne and Northern, and Tremont, Elkhorn and Missouri Valley are by Prof. G. E. Bailey, of the Dakota School of Mines, Rapid City, South Dakota. A portion of the latter road should be in the Nebraska chapter, but was overlooked when that chapter was printed.

40. By Mr. G. K. Gilbert, Geologist, U. S. Geological Survey.

41. From Acheron to Price the road follows a great monoclinical valley overlooked on the north by the Book Cliffs (Cretaceous). G. K. G.

42. The north end of the Oquirrh Range from Chambers to Lake Point is finely carved by old shore lines of Lake Bonneville. These extend up to 1,000 feet above Great Salt Lake. G. K. G.

43. From Spanish Fork to Lehi the road is in Utah valley and commands a view of the old shore lines of Lake Bonneville. A large delta of the old lake forms the terrace near Provo. G. K. G.

44. There is a profound fault along the western base of the Wasatch range. The hot springs close to the track between Salt Lake City and Wood's Crossing rise on the fault line. G. K. G.

45. *Ogden*. View of Wahsatch Mountains to east, a very fine range, as seen in afternoon light, when eastern train arrives; southeast, Archæan, with Weber Canon cut in it, through which the railroad has come out into valley; east, "Fault Canon," faulted Cambrian lying on Archæan, recognized by color; Ogden Canon; northeast, Eden Pass, another fault; north and north-northeast, Paleozoic rocks on Archæan. Lake terraces show all along base of mountains, by gray horizontal line, very distinct. W. M. Davis, Jr., of Harvard College.

46. *Utah Central Railroad*. Leaving Ogden and rounding long Quaternary slope south of Weber River, a long stretch of Wahsatch range comes into view. From Fault Canon, north; Archæan, at base; Paleozoic, above; between Fault Canon and Centreville station, including Weber Canon, all Archæan. Then begins the great synclinal, as seen from along here. The north end, a little south of east from Centreville (Cambrian to Carboniferous) shows on top of mountains; and the south end. Twin Peaks (Cambrian), and Lone Peak (granite intruded through Archæan), in farthest distance, showing over lower Tertiary hills south of Centreville. The axis of the synclinal (of soft, Mesozoic rocks) being low and hidden. The old lake terrace is very clearly seen. W. M. D.

47. *Centreville to Salt Lake City*. Around west base of hills, formed of Paleozoic rock, dipping south (part of synclinal), overlaid by unconformable Tertiary rocks. W. M. D.

San Pete Valley Railroad. ⁴⁰			Nevada.		
Ms.		Alt.			
	Nephi.	20. Quaternary.	Eureka and Palisade Railroad. ⁴⁹		
	Fountain Green.	19. Tertiary.	Ms.	Continued.	Alt.
	Moroni.	"			
Union Pacific Railroad. ⁴⁰ —Continued.					
Echo and Park City Branch.					
0	Echo.	Wasatch; Tertiary.	37	Mineral. ⁵¹	20. Quaternary.
8	Grass Creek Jo.	18. Upp. Creta.	50	Alpha.	"
5	Coalville.	"	60	Garden Pass.	"
13	Wanship.	"	63	Summit. ⁵²	"
20	Atkinson.	14. Carbonifer's.	78	Diamond.	"
27	Park City.	"	90	Eureka. ⁵³	Pumice and Tufa. ⁵³⁷¹
Nevada.			Virginia and Truckee Railroad. ⁴⁹		
Eureka and Palisade Railroad. ⁴⁹					
0	Palisade. ⁵⁰	Rhyolite.	0	Reno.	20. Quaternary.
12	Evans.	20. Quaternary.	11	Steamboat. ⁵⁴	Hot Springs deposits.
28	Box Springs.	"	21	Franktown.	Metamorphic rocks.
			30	Carson. ⁵⁵	19 c. Humb't Plio. ⁴⁶³⁰
			89	Eureka.	20. Quaternary.
			52	Virginia. ⁵⁶	Andesite.

48. *Salt Lake City.* Walk north, one hour, to Ensign Peak, (or better, an hour further north-east, to point whence northeast can be seen also—giving fine view in all directions.) The Wahsatch range fills the east, from north to south. Other mountains are: Northwest, Antelope Island, in lake, Archæan; north-northwest, beyond Antelope Promontory Mountains and Island; west, Lakeside, Stansbury and Cedar Mountains; southwest, Oquirrh Mountain; west-southwest, Aquil Mountain; south, Pelican Mountain, (beyond Traverse)—Carboniferous, all running north and south; south, Traverse Mountains, east and west—Trachyte—cut through in middle of River Jordan, coming from Utah Lake (fresh of course), north to Great Salt Lake. From Ensign Peak can be seen the city; the fertile valley of the Jordan (fertile from irrigation); the lake; Camp Douglas (U. S. troops) on terrace east of and commanding city; Emigration Canon, through which the Mormons first came to the valley. Salt Lake is better than Colorado Springs for excursions.

49. By Mr. Hague.

50. *Palisade.* Andesite and basalt near by.

51. *Mineral.* Devonian limestones in the hills of the Pinon Range.

52. *Summit.* The railway crosses a low pass of the Pinon Range.

53. *Eureka.*—All the characteristic types of the volcanic rocks of the Great Basin occur in the immediate neighborhood.

54. *Steamboat.* Well-known steamboat springs depositing Silica. Andesite near the railway.

55. *Carson.* Fossil remains in the sandstones near the Prison.

56. *Virginia.* The famous Comstock Lode is here, an excellent place to study the volcanic rocks of the Great Basin.

Lake Bonneville is the name given to the great Quaternary lake, whose boundary has been traced by its shore lines and deposits to and into Nevada on the west, Idaho on the north, as far east as Salt Lake City and in bays of which Utah and Sevier Lakes are the remnants, to the south as far as Frisco. The Great Salt Lake is the reduced remnant of this great sheet of water. The highest, or Bonneville, shore line is 1,000 feet above the level of Great Salt Lake, and is one of the most conspicuous water lines. Of the numerous lower lines, marking the heights at which the water lingered, one lying 400 feet below the highest is called the Provo shore line. Between the Bonneville and Provo lines are four or five prominent lines.

The following, from Mr. G. K. Gilbert's report on Lake Bonneville, gives, in a general way, its origin. "The lowlands of the 'Great Basin' are valleys without drainage to the ocean, and when the climate of the Glacial Epoch gave them a more generous supply of moisture, the surplus was accumulated in their lower parts in quantities which bore a definite relation to the climate. When for centuries the climate became more humid, the lake rose and encroached upon the land, and when the reverse was true and aridity prevailed, they dried away and the land was laid bare." The origin and history of the great lakes of former periods is a subject of absorbing interest to the student of geologic science, and none offers a better field than Lake Bonneville.—[Ed.]

Oregon.¹

Oregon & California Railroad. (Up the Willamette Valley.)			Ms.	Alt.	Oregon & California Railroad. Continued.			Ms.	Alt.
0	Portland.	Hills on west. Basalt alluvial gravel plain east. 19 b. Miocene fossils in the river bed.	43		87	Tangent.	269		
7	Milwaukee.	Basalt hills.	117		98	Halsey.	307		
11	Clackamas.	"	134		106	Harrisburg.	332		
16	Oregon City.	Bed of river and hills on both sides columnar basalt.	99		110	Junction.	345		
20	Rock Island.	A transverse dike of trap, with amygdaloid. Hills of basalt. The bed of the river and the now widening valley of 20.			124	Eugene.			
25	Canby.	Post Pliocene contain abundant fossil remains of <i>bos</i> , <i>latifrons</i> , <i>elephas</i> , mastodon and horse.	175		135	Creswell.	565		
29	Aurora.	The streams here to right and left expose the 20. Post Pliocene mud.	218		145	Latham.	657		
33	Hubbard.	The river bed is 20. Post Pliocene. The hills are rich with 19 b. Miocene marine fossils.	206		148	Divide.			
40	Gervais.	A ridge of dark colored 19. Tertiary crosses the line of travel here—rich in fossils.	210		156	Comstock.			
53	Salem.		187		161	Rice Hill.			
61	Turner.		310		181	Oakland.			
67	Marion.		322		200	Roseburg.			
72	Jefferson.		264		213	Dillard.			
	(Exposure a mile above the town on the Santiana River.)				231	Riddle's.			
81	Albany.	The above rock seen across the river.	238		267	Glendale.			
					296	Grant's Pass.			
					320	Gold Hill. ²			
					335	Medford.			
					340	Phoenix.			
					349	Ashland. ³⁺⁴			

1. Furnished for this work by Prof. Thomas Condon, of the Oregon State University, Eugene City, Oregon, the State Geologist.

2. *Gold Hill to Ashland.* Gold mining Auriferous slates.

3. Notes on this stage line are by J. S. Diller, of U. S. Geological Survey Corps.

4. *Ashland.* Liskiyan Mountains and hills, west of road, chiefly of granite and Metamorphic rocks; those on east chiefly Cretaceous strata and lavas (basalt and andesite).

5. *Yreka.* Cretaceous fossils (chico group) eight miles northeast of Yreka.

Scott's Mountains, chiefly Metamorphic rocks, serpentines and granites.

Six miles northwest of Gazelle, at Cave rock, coarse conglomerate of Cretaceous shore line against Scott Mountains. Three miles west of Gazelle Carboniferous limestone with fossils.

6. *Shasta Valley.* Remarkable for great number of volcanic cones. Grand view of Mount Shasta.

Ascent of Mt. Shasta from *Sissons*, by good trail to camp at timber line, three hours; to summit from camp about six hours, partly on horseback. Glaciers and cañons on north and east sides of mountain. One of the finest volcanic cones in the world. Shasta chiefly Hypersthene andesite. Sugar Loaf is of Hornblende andesite. Mt. Shasta, 14,442 feet above tide, or nearly 11,000 above Berryvale. Dr. G. W. Dawson says, in its grand isolation, and the remarkable symmetry of its conical form, it is very impressive.

Southern Pacific Railroad.			Oregon Railway and Navigation Co.		
Ms.	San Francisco and Portland Line. ¹⁰	Alt.	Ms.	Continued.	Alt.
0	Ashland ⁴	See Notes.	1453	Encina.	See Note 9. 3960
36	Hornbrook.	"	1457	Norton.	" 3680
54	Montague.	"	1463	Baker City.	" 3440
	(Yreka. ⁵)	"	1474	Haines.	" 3835
76	Sission. ⁶	"	1483	North Powder.	" 3280
98	Dunsmuir.	"	1493	Telocaset.	" 3449
	(U. Loda Sp's. ⁷)	"	1503	Union.	" 2720
125	Gibson.	"	1515	La Grande.	" 2786
134	Delta, Cal.	"	1522	Hilgard.	" 3004
Oregon Central Railroad.			1534	Kamela.	" 4204
0	Portland. ⁸	{ Hills of basalt, over- lying 19 b. Mio. 48	1540	Meacham.	" 3681
6	Summit.	{ salt.	1548	Laka.	" 2909
9	Ross Landing.	{ "	1557	North Fork.	" 2808
		{ To Forest Grove over the bed of the 20. Post Miocene in- land sea, connected with the main one of Willamette Val- ley, through the Tualatin and Che- halem Valley.	1558	Wilbur.	" 2282
11	Beaverton. 212		1568	Mikecha.	" 1751
16	Readsville. 253		1578	Cayuse.	" 1414
24	Hillsboro. 193		1586	Mission.	" 1183
29	Cornelius. 200		1589	Pendleton Jo.	" 1130
	Forst Gr'v'e, 193		1590	Pendleton.	" 1070
		{ Hills of fossil rock right and left, 19 b. Miocene. 206	1597	Barnhart.	" 913
32	Gaston.	{ "	1605	Y oakum.	" 835
48	St. Josephs.	{ "	1608	Nolin.	" 736
Oregon Railway and Navigation Co.			1615	Echo.	" 689
1416	Huntington, Or.	See Note 9. 2110	1618	Foster's	" 592
1428	Weatherby.	" 2395	1627	Maxwell.	" 452
1436	Durkee.	" 2650	1634	Umatilla Jo.	" 300
1443	Unity.	" 2128	Heppner Branch.		
1451	Pleasant Val.	" 2750	0	Arlington.	See Note 8.
			10	Willows Jo.	" 241
			25	Cecil.	" 625
			30	Douglass.	" 796
			39	Ione.	" 085
			46	Lexington.	" 1426
			55	Heppner.	" 1905

7. *Upper Loda Springs.* Near Upper Loda Springs, an ancient Lava stream from Mt. Shasta enters the Cañon of the Sacramento River, which it follows for nearly 50 miles. Lava seen at many places clinging to sides of old Cañon, especially near Delta.

8. Dr. Dawson discovered in Oregon, west of the Cascade Mountains, no traces of general glaciation or deposits like northern drift. There is a remarkable absence of any well marked terraces or benches, although the bottoms of the valleys suggest that the sea may have at one time flowed into them. The almost complete absence of lakes or ponds is very remarkable, and contrasts strongly with the innumerable lake basins of British Columbia. The drift appears at Tacoma and other places in Washington.

9. This line of the Oregon Railway and Navigation Co. traverses a region covered by the great lava sheet, but just what formations are exposed at given stations can not be determined from any sources at the command of the editor. Prof. Condon's notes, the general note 39 on the Northern Pacific, and Mr. Willis' notes on pages 265 and 266 will throw some light on the geology of this section. Other lines of the Oregon Railway and Navigation Co. will be found in the chapter on the Northern Pacific. J. R. M.

10. The notes on this line were prepared before the road was built (see Note 3,) and as they are all that I can obtain for this line I have inserted the old stage stations in parentheses. J. R. M.

California.*

LIST OF THE GEOLOGICAL FORMATIONS IN CALIFORNIA.

TERTIARY.	20. Quaternary.	
	19 c. Pliocene.	
	19 b. Miocene.	
	19 a. Eocene.	
	18. Cretaceous.	W. of Sierra Nevada.
	17. Jurassic.	W. and E. of Sierra Nevada.
	16. Triassic.	" " "
	14. Carboniferous.	E. of " "
	13. Sub-Carboniferous.	W. and E. " "
	9-11. Devonian. ?	E. of " "
	5-7. Silurian. ?	" " "
	2-4. Cambrian. ?	" " "
	1. Archæan. ¹	W. and E. " "

***Explanatory Note.** This chapter was prepared by my father just before his death, principally from notes furnished by Dr. J. G. Cooper, whose name is given at note 1 as the authority for most of the chapter. Through some misunderstanding the plates were made before Dr. Cooper had finally corrected the proofs, and in the haste to release the type an unusual number of errors, most of them in orthography, were overlooked. Many of these are apparent and need no further explanation; others are explained in the *errata* at the end of the chapter. While it is thought best to publish the chapter as it stands, it is only just to Dr. Cooper to say that he is in no way responsible for the insertion of, or the statements in, any of the notes or tables, except his own, also that he would make some alterations, based upon recent investigations, if the whole chapter were revised.

J. R. M.

General Note on the Topography of California.

The two prominent features, extending through nearly the entire length of the State of California are the snow-capped range of the Sierra Nevada on the eastern border, and the low Coast Range, or rather belt of ranges, bordering the sea coast on the west. Between the two lies the great valley of California, drained from the northward by the Sacramento, and from the southward by the San Joaquin rivers, and these uniting near the middle of the length of the valley, pass westward through the narrow Strait of Carquines into San Francisco Bay, and thence through the Golden Gate into the Pacific Ocean. These two rivers receive nearly all their waters from the Sierra Nevada, the streams flowing landward from the Coast Range being insignificant. The main drainage of the Coast Range is to seaward, through many small rivers bordered by fertile valleys. The immediate coast is mostly abrupt and rocky and frequently mountainous. The Great Valley, from the Tejon Mountains on the south to Red Bluff on the north where the valley proper terminates, is about four hundred miles in length, and its width varies from over sixty to somewhat less than forty miles. The northern part, or Sacramento Valley, is about 160 miles long, from Red Bluff to the Calaveras River, and is seven miles wide at the head, widening in three miles to fifteen, and then expanding suddenly to about forty miles. The southern or San Joaquin valley is two hundred and forty miles long, and its prominent topographical feature is the Tulare Lake and the basin surrounding it.—*E. W. Cragg, in Cotton Report of U. S. Census.*

General Note on the Geology of California.—Broadly speaking the *Coast Range* of California consists of Tertiary and Cretaceous, mostly sandstones and calcareous clay slates, almost everywhere greatly disturbed, folded, and frequently highly metamorphosed, and traversed by dikes of eruptive rocks and upheaval axes. In the portion north of San Francisco these are frequently by tuffaceous and scoriaceous, or crystalline lava flows, emanating from distinct volcanic vents now extinct.

In contrast to the Coast Range the *Sierra Nevada* has in general a central axis of granite or other rocks, occasionally traversed by volcanic vents, on the flanks of which lie more or less crystalline and metamorphic slates or schists of Paleozoic, Triassic, and Jurassic age, with edges upturned at a high angle or sometimes vertical. Abutting against this, the proverbial "bed rock" of the California miners, there lies on the border of the great valley strata of marine deposits, mostly of the Tertiary, but northward also of the Cretaceous age, which are but slightly disturbed, and into which the rivers flowing from the Cañons of the Sierra have cut their immediate valleys, flanked by bluffs from forty to seventy feet high. From opposite San Francisco northward, on the lower foothills, appear immense gravel beds, mostly gold bearing, and these are partly over-laid by eruptive or volcanic outflows and tuffaceous rocks, also accounted as belonging to the Tertiary age. In the northern portion of the Sierra region the eruptive rocks become more and more prominent, covering an enormous area called the "lava bed" in the northeastern part of the State, and, as in the Cascade Range, in Oregon, forming the body of the comparatively low range, upon which the volcanic cone of Mount Shasta is superimposed. (See Note 39 on Northern Pacific Railroad.)

Central Pacific Railroad.			Central Pacific Railroad— Continued.		
Ms.		Alt.	Ms.		Alt.
.....	State Line.	20. Quaternary.	731	Arcade.	20. Quater. Alluvial. ⁵⁵
616	Boca. ⁴	5531	744	Sacramento.	" 30
624	Truckee.	5819	.....	Sacramento.	" 30
638	Summit.	6933	.....	Elk Grove.	" 32
652	Cisco. ⁴	5934	525	Galt.	" 49
660	Emigrant Gap. ⁵	5221	607	Stockton. ⁸	" 28
665	Blue Cañon.	4693	650	Lathrop.	" 26
675	Alta.	3607			20. Quaternary.
677	Dutch Flat.	3395	706	Banta.	{ 19. Tertiary, Plio.,
679	Gold Run.	3220			{ 19 b. Miocene & lig-
680	Colfax.	2422	718	Tracy.	nite, 19. Eocene(?) ⁵⁰
701	Clipper Gap.	1759	745	Byron.	20. Quaternary.
707	Auburn. ⁵	1860	815	Antioch.	"
712	Newcastle. ⁶	956	859	Martinez.	{ 18. Cretaceous and
718	Pino.				{ 19. Eocene.
721	Rocklin. ⁶	249	863	Port Costa.	18. Cretaceous.
725	Junction.	163	877	San Pablo.	20. Quaternary.
729	Antelope. ⁷	{ Quaternary, above Granite (Arch.) ¹⁵⁴	890	Oakland Pier. ⁹	" 14
			895	San Francisco. ¹⁰	18. Meta. Cretaceous.

Apart from the Cretaceous and Tertiary beds on the borders of the great valley, there are within the valley terraces and bench marks showing the existence in *Quaternary* times of a great fresh-water lake, which was subsequently drained by the erosion or breaking, first of the Strait of Carquines, and ultimately of that of the Golden Gate. Prior to the latter event, the drainage of the great valley passed through the Santa Clara and Pajaro valleys into the Bay of Monterey. The latest surface deposits are in the San Joaquin valley, mostly sandy, and in the Sacramento valley more commonly clay "adobe," corresponding to the composition of the Coast Ranges opposite to each district. —E. W. Hilgard, in *Census Cotton Report*.

As the railroads are nearly all constructed in the valleys on the Quaternary formations just described, there is very little variety in the tabular list of formations passed over and immediately adjoining the railroads. The notes on adjacent mountains impart some interest to the country for the geologist.

1. By Dr. J. G. Cooper, of Hayward's, Cal., late Assistant State Geologist under Professor Whitney, with some notes derived from Prof. E. W. Hilgard's U. S. Census Cotton Report, and other sources.

2. *Tertiary*. Both marine and fresh water in the Coast Range and Sierra Nevada Mountains, but not yet defined and much of it volcanic.

3. *Archæan*. Much of the Granite is also eruptive (19. Tertiary), but may be remelted Archæan.

4. *Boca to Cisco*. Volcanic and glacial, with 1. Archæan (granite) and metamorphosed rocks of uncertain age. Metalliferous but not rich. Mt. Stanford, northward, is 9,500 feet high.

5. *Emigrant Gap to Auburn*. Glacial and detrital above 16. Triassic and 17. Jurassic sandstones, containing most of the gold mined on the western slopes. A fine iron mine seven miles north of Auburn.

6. *Newcastle to Rocklin*. Detrital above 1. Archæan granite, surface mining for gold, platinum, tellurides of silver and nickel. Diamonds also occur in small quantities.

7. *Antelope*. The mountains to the east produce lime, marble, copper ore and some lignite (19 c. Pliocene.)

8. *Stockton*. Mt. Diablo, 3,876 feet high, is in full view and easily ascended from near the coal mines.

9. *Oakland and San Francisco*. *The Golden Gate and Bay of San Francisco*. This Bay has been celebrated, from the time of its first discovery, as among the finest in the world, and is justly entitled to that character, even under the seaman's view of a mere harbor. But when all the accessory advantages which belong to it are taken into the account, it rises into an importance far above that of a mere harbor. The Bay of San Francisco is separated from the sea by low (Cretaceous) mountain ranges. Looking from the peaks of the Sierra Nevada, the Coast Mountains present an apparently continuous line, with only a single gap, resembling a mountain pass. This is the entrance to the great bay, and is the only water communication from the coast to the interior country. Approaching from the sea, the coast presents a bold outline. On the south the bordering mountains come down in a narrow ridge of broken hills, terminating in a precipitous point, against which the sea breaks heavily. On the northern side the mountains present a bold promontory, rising in a few miles to a height of two or three thousand feet. Between these points is the strait, about one mile broad in the narrowest part, and five miles long from the sea to the bay. This passage is called the Golden Gate. The form of the entrance into the Bay of San Francisco, and its advantages for commerce, suggested the name long before the discovery of gold in California, and by analogy to the Golden Horn of Constantinople. Passing through this gate, the bay opens to the right and left, extending in each direction about thirty-five miles, having a total length of more than seventy, and a coast of about two hundred and seventy-five miles. It is divided by straits and projecting points into three separate bays, of which the northern is called San Pablo, the middle one Suisun, and the southern San Francisco. Within the view is that of an interior lake of deep water lying between parallel ranges of mountains, rising two thousand feet above the water, and behind the rugged peak of Mount Diablo, thirty-seven hundred and seventy feet high, over-looking the bay and surrounding country. Islands, which have the bold character of the shores, some mere masses of rock, and others originally grass-covered, rising to the height of three and eight hundred feet, break the surface of the bay, and add to its picturesque beauty.

J. C. FREMONT.

Central Pacific Railroad— Continued.			Central Pacific Railroad— Continued.		
Ms.		Alt.	Ms.		Alt.
.....	Sacramento. ¹²	20. Quaternary.	80		
13	Davis.	"	54		
21	Dixon. ¹¹	"	65		
29	Elmira. ¹²	"	75		
40	Suisun.	"			
57	Benicia.	"			
58	Port Costa.	18. Cretaceous.			
61	Vallejo Junction.	"			
66	Pinole.	19 b. Miocene, Tertiary			
69	Sobranste.	"			
72	San Pablo.	20. Quaternary.			
84	West Oakland.	"			
85	Oakland Pier.	"			
90	San Francisco.	18. Met. Cretaceous.			
.....	San Francisco. ¹⁰	"			
5	Oakland Pier. ⁹	20. Quaternary.	14		
7	Oakland (16th Street).	"			
10	West Berkely.	"			
18	San Pablo.	"			
21	Sobranste.	19 b. Miocene Tertiary			
24	Pinole.	"			
27	Tormay. ¹³	18 c. Cretaceous.			
29	Vallejo Junction.	"			
32	Port Costa.	"			
36	Martinez.	18. Cre. & 19 a. Eocene.			
39	Avon.	20. Quaternary.			
42	Bay Point.	19 c. Pliocene Tertiary			
50	Cornwall. ¹⁴	20. Quaternary.			
55	Antioch.	"			
63	Brentwood.	"			
68	Byron.	"			
77	Bethany.	"			
83	Tracy.	"			
			86	Banta.	{ 19 c. Tertiary Plia, 19 b. Miocene lignite, 19 a. Miocene.
			94	Lathrop. ¹⁵	20. Quaternary.
			105	Ripon.	"
			108	Salida. ¹⁶	"
			114	Modesto.	"
			119	Ceres.	"
			127	Turlock.	"
			137	Livingston.	"
			162	Merced.	"
			162	Athlone.	"
			178	Berenda.	"
			185	Madera.*	"
			197	Sycamore.	"
			207	Fresno.	"
			216	Fowler.	"
			227	Kingsburg.	"
			235	Cross Creek.	"
			241	Goshen. ¹⁸	"
			.....	Tagus. ¹⁶	"
			251	Tulare.	"
			262	Tipton. ¹⁷	"
			.....	Alila.	"
			282	Delano.	"
			294	Poso.	"
			302	Lerdo.	"
			314	Sumner. ¹⁸	"
			321	Wade.	"
			329	Pampa. ¹⁹	"
			336	Caliente. ¹⁶	"
			342	Bealeville.	1. Arch. Granite.
			350	Keene. ²⁰	19 c. Plio. Gravel.

* The road to Yosemite Valley is from this place.

10. *San Francisco.* The rock on which the city rests belong entirely to the metamorphic-cretaceous series, and is not the Lignite or Eocene, or Tejon beds which bear the coal, as given in the first edition.

11. The islands in the bay are all like San Francisco in structure.

12. *Elmira to Sacramento.* The coast range westward, 5,000 to 8,000 feet high, is little explored, but resembles that south of San Francisco Bay, with much more volcanic, and towards the north auriferous, but only granitic or metamorphic rocks, containing the gold quartz, underlie the cretaceous, as far as now known.

13. *Tormay.* Fossils of both formations are more plenty and better than elsewhere near San Francisco Bay.

14. *Cornwall.* Good fossils are to be found in Kirker's pass, three miles south of Cornwall. The coal mines, five miles south, are not now worked, but a ride to the summit of Mt. Diablo, ten miles, is interesting.

15. *Lathrop to Goshen.* The "High Sierra," 14,000 to 15,000 feet, can be seen on clear days. The mountains eastward have the same general character as on the line from Boca to Sacramento, with the addition of some 18. Cretaceous uplifts near base.

16. *Salida.* Table Mountain, made famous by Bret Harte's humorous poem, rising some 2,000 feet above the Stanislaus river, has a length of about 30 miles, its flat top being from 1,200 to 1,800 feet wide. A prominent feature in the topography of Amador, Calaveras and Tuolumne counties is the occurrence of belts of lava-capped hills and mountains, as well as deposits of other volcanic material, the remains of what were once lava flows from the Sierra mountains westward. The Table Mountain is a flow of lava, originating in the lofty volcanic region beyond the "big trees" of Calaveras.

17. *Tipton.* A great bed of magnesite twenty miles east.

18. *Sumner.* A great vein of antimony overlies 40 miles due south near Mt. Pinos, 6,000 feet; elevation of mountain being 7,000 feet.

19. *Pampa.* For several miles east the roads pass through hills of 19. Pliocene, Tertiary gravels and clays, with volcanic and other detritus overlying metamorphic shales, etc., that may be 18. Cretaceous or 19. Eocene.

20. *Keene.* Broken terraces of 19 c. Pliocene, Tertiary age, chiefly of volcanic materials for five or six miles.

Ms.	Central Pacific R. R.—Con.	Alt.	Ms.	Central Pacific R. R.—Con.	Alt.
.....	"The Loop."*		439	Lang.	1661
355	Girard. ²¹	18. Sub Carb. l. s. 3301	452	Newhall.	20. Quaternary. 1363
.....	Tyler.	" 3305	.....	Andrews.	" 1333
362	Tehachapi. ²²	1. Arch. Granite. 3964	456	S. F. Tunnel. ²⁷	19 c. Plio. Tertiary 1401
.....	Summit Siding.	" 4025	461	San Fernando.	20. Quaternary. 1066
371	Cameron. ²³	18. Sub Carb. l. s. 3737	.....	Lulmuga.	" 950
.....	Nadean.	" 3357	474	Sepulveda.	" 461
382	Mojave. ²⁴	20. Quaternary. 2751	482	Los Angeles. ²⁵	" 393
.....	Gloster.	" Desert Region. 2555	484	Shorb.	" 460
396	Rosamond. ²⁵	" 2315	491	San Gabriel.	" 409
407	Lancaster.	" 2330	494	Savanna.	" 396
417	Alpine.	18. Sub Carb. l. s. 2322	496	Monte.	" 336
.....	Vincent.	" 3211	502	Puente.	" 323
427	Acton. ²⁶	17. Jurassic. 2678	512	Spadra.	" 705
431	Ravena.	" 2350	515	Pomona.	" 856

* The railroad here describes a circle and crosses itself.

21. *Girard.* Beds of 13. Lower Carboniferous limestone on granite hills near by, one crossing the road; good marble, common, some vesicular basalt also.

22. *Tehachapi.* Gold mines in gravel, and quartz veins near by.

23. *Cameron.* The pass through Sierra Nevada here resembles other sections northward; some auriferous slates, 17. Jurassic (?), are worked in vicinity also.

24. *Mojave.* The desert region known as the Mojave Desert, and east of the Sierra Nevada the Colorado Desert or basin, reaches far eastward into Arizona, and affords, by this route, one of the strangest railroad rides in the world. It is a sandy barren waste, interspersed with salt lakes and alkali tracts, destitute of all timber growth, except occasional tracts of yucca, small nut pines and juniper. In the south it is subject to very frequent and severe sand storms. Enough of it to satisfy the traveler is seen along the line of this railroad for hundreds of miles. A boiling Mud Lake is only a few hundred yards southwest of the road (See notes 25, 29, 30 and 31.) But probably the culminating point of this fearful desert is found in "Death's Valley," far from any railway station, near the eastern line of California. It is four hundred feet below the level of the sea, while but seventy miles west of it are clustered a number of the highest peaks of the Sierra Nevada, many of which are from 12,000 to 15,000 feet in height. For 45 miles in length and 15 in width along its centre it is a salt marsh with a thin layer of soil, and a large portion of the basin is covered with an incrustation of salt and soda several inches thick, destitute of the slightest vegetation. The heat of the valley is fearful during the summer. Whatever may be the rock formation underlying the desert is of no importance, as its existence is not due to that, but to the aridity of the climate and to the excessive deposits of alkali on the surface and mingled with the superficial formations. For a description of the alkali, see note No. 25.

25. *Rosamond.* The Alkali, so injurious to extensive regions of the southwest, has been carefully studied in California by Prof. E. W. Hilgard. His analyses show the presence of from one to four per cent of these injurious salts in 100 of soil. Of these salts, from 20 to 50, and in some cases 75 per cent, the proportions varying very much in different places, is sulphate of sodium or glauber salt; from 10 to 20, and sometimes 30 per cent, chloride of sodium or common salt, from 15 to 60 per cent, of carbonate of soda or sal-soda, sometimes from five to 20 per cent, of sulphate of potassium, a less quantity of carbonate of potassium or saleratus, and other salts injurious to vegetation in various quantities, phosphates, nitrates, etc.

The remedy for the reclamation of alkali lands is, of course, the leaching out of the injurious salts, by flooding with pure water and underdraining. Unfortunately, in many cases, the alkali returns and again increases on irrigated lands, rising from below through the agency of the water evaporated on the surface, which causes a greater depth of sub-soil to be drawn upon for its alkali, where, too, the soil is more highly charged with it than at the surface. The origin of the alkali is not fully determined. Professor Hilgard thinks much of this salty matter pre-existed in the geological strata, as it is seen to "bloom out" from the rocks, and that from these it was continually washed out in Quaternary times by percolating water, when great lakes covered the valleys of California, for a time held in suspense and then precipitated, or in some cases by the drying-up of the lakes the salts were deposited, which are now found accumulated in the soil. But the very great quantities of the alkali may be said not to be satisfactorily accounted for. The alkali has a corrosive action upon the root crowns and upper roots of plants. It seems that the cotton plants, having long tap roots, it is less injurious to them than to others. Another injurious effect it has in hardening clay soils, producing a tamped condition, instead of the flocculent state which we see in a well tilled and productive soil.

26. *Acton.* Iron and copper mines occur near here.

27. *San Fernando Tunnel.* On west side of pass the sandstones reappear with marine fossils. Tunnel through 18. Cretaceous and 19. Tertiary hills.

28. *Los Angeles.* The hills northward are metamorphic (18. Cretaceous?), with a great 19. Tertiary (19 b. Miocene and 19 c. Pliocene) basin between them and the range north of San Fernando. To the east more metamorphic and granitic, with auriferous quartz, copper, etc. The 19. Tertiary contains much petroleum.

Los Angeles. The traveler from the eastward who has begun to despair of ever seeing anything greener than giant cacti and adamantine vegetation which dispenses with water, is agreeably surprised as he approaches Los Angeles. A drive through the place will enable you to appreciate the reasons which induced the Spanish founders to give the city its name.

W. H. R.

Los Angeles to Anaheim. Alabaster and gypsum occur in low 19. Tertiary hills near here.

Los Angeles to El Cerrito. About half way the metamorphic and granitic hills approach the road. Much 19 b. Miocene Tertiary, with poor lignite, caps these on the west.

Los Angeles to St. Monica. See note 89.

Central Pacific Railroad— Continued.			Central Pacific Railroad— Continued.		
Ms.		Alt.	Ms.		Alt.
521	Ontario.	20. Quaternary.	981		
525	Cucamonga.	"	952	..... Rattlesnake.	Desert Region.
.....	Sansevain.	"	1074	761 Abonde.	"
540	Cotton.	"	985	771 Taona.	"
543	Mound City.	"	1055	..... Mohawk Sum't.	"
547	Brookside.	"	1810	798 Texas Hill.	"
554	El Casco.	"	1874	806 Aztec.	"
568	San Gorgonio. ²⁹	"	2560	..... Stanwix.	"
569	Banning.	"	2317	821 Sentinel.	"
575	Cabazon.	Col. Desert Region	1779	834 Painted Rock.	"
583	White Water.	"	1126	850 Gila Bend.	"
591	Seven Palms.	"	584	860 Bosque.	"
.....	Dry Camp.	"	163	869 Estrella.	"
612	Indio. ³⁰	"	30	878 Montezuma.	"
625	Walters.	"	195	887 Maricopa.	"
637	Salton.	"	163	902 Sweet Water.	"
642	Dos Palmas. ³¹	"	253	913 Casa Grande.	"
653	Frinks.	"	260	923 Toltec.	"
.....	L. Point 1 mi. E. of Frinks.	"	263	932 Picacho.	"
.....	Volcano.	"	235	946 Red Rock.	"
661	Volcano S'gs.	"	220	961 Rillito.	"
671	Flowing Well. ³⁰	"	5	..... Jaynes.	"
676	Tortuga.	"	133	978 Tucson.	"
682	Mammoth Tank.	"	257	..... Wilmot.	"
694	Mesquite.	"	294	993 Papago.	"
708	Cactus.	"	396	1007 Pantano.	"
716	Ogilby.	"	353	1016 Mescal.	"
722	Pilot Knob.	1. Arch. Gran. & Vol.	385	1024 Bensen.	"
.....	El Rio. ²⁹	"	164	1034 Ochoa.	"
.....	Col. River Bdge.	"	189	1044 Dragoon Sum't.	"
ARIZONA.			1054	Cachise.	"
781	Yuma.	20. Quaternary.	140	1064 Willcox.	"
.....	Araby.	"	144	1073 Railroad Pass.	"
745	Gila City.	" Desert Region.	171	1088 Bowie.	"
			1104	San Simon.	"

29. *San Gorgonio*. Metamorphic auriferous rocks (secondary) overlying granite, chiefly on the west side. San Bernardino Mountain is 11,600 feet high.

San Gorgonio to El Rio. The railroad plunges into the most remorseless, cruel waste of sand and rock I ever beheld. It spreads out up to the foot of the rugged hills of the Bernardino range, an abomination of desolation, compared with which the Lybrian Desert is the Garden of Hesperides. I cannot describe, nor could I at any time hope to give an adequate conception of this dreadful wilderness. For 107 miles there is not a drop of water to be found, but Nature, as if to take away the reproach of permitting such a vast blotch on her fair face, kindly threw in Fata Morgana. We saw with delight wide spread lakes, with fairy islands in the midst; placid seas washing the base of the distant hills. This baked and dreary expanse extends from near San Gorgonio nearly to El Rio.

WM. HOWARD RUSSELL.

30. *Indio to Flowing Wells*. For 61 miles the road is below sea level, going down to 263 feet on the border of 19. Pliocene Tertiary lake bed which contains fresh water fossil shells, and below them beds of salt, from being once the head of the Gulf of California; on its west side are 19 b. Miocene Tertiary sandstone strata, with marine fossils, lying against east slope of Coast Mountains. Hot springs and mud volcanoes also occur in the lake bed near its centre; some of our rarest minerals are found in the neighboring mountains.

31. *Dos Palmas*. A few miles southwest of this place is a broad valley in which is the dry bed of a lake forty miles in circumference. Nearly in the centre of this plain, there is a lake of boiling mud about half a mile in length by five hundred yards in width. In this curious caldron the thick, grayish mud is constantly in motion, hissing and bubbling, with jets of boiling water and clouds of sulphurous vapor and steam bursting through the tenaceous mud and rising high in the air with reports often heard at a considerable distance. The whole district around the lake trembles under foot, and subterranean noises are heard in all directions.

32. *Deming*. The San Luis Mountains, on the Mexican side of the river, rise abruptly from the plain, as they run south, and assume by far the most formidable appearance of any range west of the Rio Grande. Tombstone mining region is in this mountain. This stupendous range of Mexican mountains drops abruptly a few miles north of the boundary, as if to make room for a railroad to connect the Pacific and Atlantic states. In fact the original boundary line was changed by a second treaty, for the express purpose of securing to the United States this great roadway, for at El Paso

NEW MEXICO.			NEW MEXICO.			
Central Pacific Railroad—Con.			Atlantic & Pacific Railroad—Con.			
Ms.	Southern Pacific Branch.	Alt.	Ms.	(Western Division.)	Alt.	
1118	Stein Pass.	Desert Region.	4351	158 Gallup.	18. Cretaceous.	6477
.....	Pyramid.	"	4301	166 Defiance.	"	6352
1138	Lordsburg.	"	4245	174 Manuelito. ⁵⁴	Base of 18. Creta.	6232
1149	Lisbon.	"	4278	ARIZONA.		
1158	Separ.	"	4508	187 Allantown.	16-17. Jura.-Tria.	6028
1169	Wilma.	"	4557	200 Sanders.	"	5807
1178	Gage.	"	4488	213 Navajo Springs.	"	5605
.....	Lunis.	"	4422	226 Billings.	"	5372
1198	Deming. ⁵²	"	4334	238 Carrizo.	"	5199
1209	Zuni.	"	4187	253 Holbrook.	"	5047
1224	Cambray.	"	4224	263 St. Joseph.	"	4979
1237	Aden.	"	4391	275 Hardy.	"	4910
1249	Afton.	"	4207	286 Winslow.	14. Carboniferous	4525
1259	Lanark.	"	4165	298 Dennison.	"	4979
1271	Strauss.	"	4088	312 Cañon Diablo.	"	4765
1281	Rogers.	"	3728	323 Angell.	"	5879
.....	Bridge over Rio Grande.	"	3748	333 Cosnino.	{ 14 Car., overlaid in places with lava	5434
TEXAS.			344 Flagstaff.	"		6862
1286	El Paso. ⁵³	Desert Region.	5713	356 Bellemont.	"	7099
Low Water in Rio Grande River about			5712	368 Chalender.	"	6837
NEW MEXICO.			378 Williams.	"	"	6727
Atlantic & Pacific R. R.* (Western Div.)			381 Supai.	"	"	6917
Albuquerque by The Needles to Mojave.			391 Fairview.	"	"	5909
0	Albuquerque.	{ Base 18. Cre., Sum- mits of 16. and 17. Jurassic & Triassic alternating.	4933	401 Ash Fork.	"	5105
10	Isleta.	"	4881	409 Pineveta.	"	5084
13	A. & P. Junction.	"	4938	419 Crookton.	"	5657
23	Luna.	"	5026	431 Chino.	"	5224
34	Rio Puerco.	"	5026	439 Aubrey.	"	5128
47	San Jose.	"	5428	452 Yampai.	"	5532
60	El Rito.	"	5638	466 Peach Spring. ⁵⁵	"	4759
66	Laguna.	"	5767	478 Truxton.	"	4172
72	Cubero.	18. Lower Creta.	5905	489 Hackberry.	"	3522
83	McCarty's.	"	6141	501 Hualapai.	"	3277
88	Baca.	"	6440	514 Beal.	"	3472
96	Grant's.	16. Triassic.	6440	516 Kingman.	"	3308
107	Blue Water.	"	6609	527 Drake.	"	
122	Chaves.	"	6969	540 Yucca.	"	1774
130	Continental Divi de.	"		553 Franconia.	"	
136	Coolidge.	"		566 Powell.	"	418
146	Wingate.	"	6714	572 East Bridge.	"	
				575 The Needles.	"	477
				..... Colorado River B. Bridge.	"	465
				..... " " Low Water.	"	440

* By Capt. C. E. Dutton, U. S. Geologist.

the great Rocky Mountain Range of the United States also terminates, thus forming what is truly the gate-way of the continent. Between the San Luis Mountains and El Paso are wide plains, bounded by detached mountains of metamorphic and other limestones, associated with igneous rocks.

53. *El Paso.* See notes in Texas chapter on El Paso.

54. *Manuelito.* A natural bridge discovered and reported by Frederick Gardner, Jr., is situated about 20 miles north of the railroad, near the line between New Mexico and Arizona. It is 65 feet long, 15 feet wide, two feet thick in the centre, and 15 feet at the sides, and about 30 feet high. This bridge is formed by a remnant of the over-lying grit, which is continuous with it on both sides. The section cut through beneath it is of light and dark red sandstone (18. Triassic). A short distance off is a petrified forest. The stone tree trunks lie just beneath the soil or half exposed, fallen in all directions.—F. G., in *Science* for July, 1885.

Atlantic & Pacific Railroad—Con. (Western Division. *)			Nev. County (N. G.) Railroad. ⁴¹		
Ms.		Alt.	Ms.		Alt.
575	The Needles, Nev.	20. Quaternary.	477	0 Colfax.	20. Quaternary.
582	Java.	Desert Region.	961	5 You Bet.	16. Trias. & 17. Juras.
589	Ibex, Cal.	"	1448	9 Storm's.	"
598	Homer.	"	2118	11 Buena Vista.	"
606	Goff's	"	2577	14 Kress'.	"
616	Fenner.	"	2087	17 Grass Valley.	"
623	Edson. ³⁶	"	1727	21 Town Talk.	"
682	Danby. ³⁷	1. Arch. Gran.	1342	23 Nevada City.	"
644	Cadiz.	"	819	San Francisco & N. P. Railroad.	
652	Bristol.	"	705	..... San Francisco.	18 c. Met. Cretaceous.
659	Amboy.	"	611	6 Port Tiburon.	"
666	Bagdad. ³⁷	"	784	12 Green Bro.	"
678	Siberia.	20. Qus.	1267	15 San Rafael. ⁴²	"
684	Ash Hill. ³⁸	"	1940	20 Miller's.	20. Quaternary.
690	Ludlow. ³⁹	"	1778	26 Nevada.	"
699	Lavic.	"	2176	35 Junction.	"
710	Haslett.	"	1863	40 Pems Grove. ³⁷	"
722	Newberry.	"	1826	46 Cotate.	"
734	Daggett. ³⁹	"	2002	51 Santa Rosa. ⁴³	"
745	Waterman. ⁴⁰	"	2118	56 Fulton.	"
754	Hinckley.	"	2159	..... Guerneville.	"
763	Harper.	"	2276	57 Mark West.	"
777	Kramer.	"	2482	66 Healdsburg.	"
795	Rogers.	"	2281	75 Clairville.	"
815	Mojave, Cal. ²⁴	"	2751	85 Cloverdale. ⁴⁴	"

* By Dr. J. G. Cooper, of California, late Assistant Geologist under Prof. Whitney. Dr. Cooper made a journey over this route specially to obtain the geology given in this table and the notes.

35 *Peach Spring* Best point now known from which to visit the Grand Cañon of the Colorado, and the only accessible point from which the descent can be made, by an easily traveled road, into as majestic and peculiar cañon scenery as is anywhere to be seen. The plates and descriptions by Dr. J. S. Newbury, in Ives' Report of 1858, give a fair idea of what is to be seen. Altogether there is nothing like this cañon. The far-famed Yosemite is more beautiful and more varied, but not more magnificent nor half so strange and weird.—A. G., in *Science*.

36 *The Needles to Edson.* Frequent outcrops of Archæan and Metamorphic rocks near road, also erupted lavas and volcanic cones of 19. Tertiary age, some perhaps 20. Quaternary. "The Needles" themselves are of purple porphyry and trachytic granite worn into sharp peaks.

37 *Danby to Bagdad.* The road passes through the granite pass of Providence Mountains for many miles; the same rocks occur as eastward and containing ores of various kinds. The mountains northward resemble those of Nevada, being Paleozoic rocks containing lead and silver, with a little gold.

38 *Ash Hill.* The west slope of the mountains descends gradually to Soda Lake, the sink of Mojave River. Death's Valley, described in note No. 24, lies nearly due north from Soda Lake, 75 to 100 miles distant.

39 *Ludlow to Daggett.* 1. Archæan Granite metamorphic and 19. Tertiary volcanic rocks lie at the west side of the sink, then cliffs of 19. Tertiary gravels, 50 to 100 feet high for 20 miles, then metalliferous rocks (Metamorphic). Abundance of soda and salt in the sink of Mojave River, other lake beds also containing borax.

40 *Waterman to Mojave.* After rising about 500 feet in the valley of the Mojave River, the road leaves it, and for 70 miles passes over an apparently level plain with little rock in sight, much of it being barren sand hills or alkaline planes, the rest with low shrubbery or groves of yucca trees 30 feet high. It is probable that this Quaternary desert covers Tertiary strata even as old as Eocene, but fossils are absent. (See Colorado Desert notes, No. 24, 25, 29, 30 and 31.)

41 *Nevada County Narrow Gauge Railroad.* The air line distance is about 16 miles, but the road winds among hills containing Archæan granite, 13 b. Sub-Carboniferous limestone, 16. and 17. Auriferous slates and quartz veins; 19. Tertiary gravels and volcanic strata much intermingled. It is the richest quartz mining region in California.

42 *San Rafael.* Mt. Tamalpais, 2,604 feet high, may be ascended here. Gives a magnificent view of the country near San Francisco Bay.

43 *Santa Rosa.* Mark West Creek, north and northwest of this place, a branch of the Russian River, has along its banks beds of Pliocene or Post Pliocene fossils. (See Pala. of Cal., by Gabb.)

The hills north of Santa Rosa are full of fossils, 19 b. Miocene and 19 c. Pliocene, but the highest ridges are more or less 18 c. Lignite and Metamorphic Cretaceous, with some coal, quicksilver, sulphur volcanic dikes frequent.

44 *Cloverdale.* The hills to the east of Cloverdale branch contain many small deposits of quicksilver.

Northern Pacific Coast R. R. ²²			California Pacific Railroad.—Con. Main Line.		
Ms.		Alt.	Ms.		Alt.
0	San Francisco.	{ 18 c. Metamorphic Cretaceous.	31	Napa Junction.	20. Quaternary.
11	San Quentin.		39	Bridgeport. ⁵²	"
15	San Rafael. ⁴²		44	Fairfield.	"
17	Junction.		55	Elmira. ¹²	"
			59	Batavia.	"
0	San Francisco.	20. Quaternary.	63	Dixon. ¹¹	"
6	Saucelito.		71	Davis.	"
10	Lyford's.		84	Sacramento.	"
15	Ross.		Marysville Branch.		
17	Junction.		0	San Francisco.	(As before).
21	Whitesville. ⁴⁵	18. Metam. Cretaceous	71	Davis.	20. Quaternary.
26	Langunitas.		81	Woodland. ⁵³	"
30	Taylorville.		85	Curtis.	"
37	Point Reyes.		90	Knight's Land'g.	"
47	Marshall's.		California Pacific & Northern Railroad.		
54	Tomales.	19 b. Miocene Tertiary	0	San Francisco.	{ (Via Oakland and San Pablo Bridge and ferry across Straits of Carquines)
61	Valley Ford.		32	Port Costo.	
65	Freestone. ⁴⁶		Ferry	to	
73	Sonoma Mill. ⁴⁷		33	Buricio. ¹	
76	Russian River.		39	Goodyear. ²	19. Tertiary Volcanic.
79	Moscow.	"	49	Suison. ³	20. Quaternary.
80	Duncan Mills.		55	Vancleu.	19 b. Pliocene.
			90	Sacramento.	20. Quaternary.
California Pacific Railroad.			Napa Branch.		
0	San Francisco.	{ 18 c. Lign. & Meta. Cretaceous.	0	San Francisco to Valley Jun., 29 miles.	
25	Vallejo. ⁴⁸		Ferry	South Vallejo.	18. Cretaceous.
31	Napa Junction. ⁴⁹	20. Quaternary.	38	Napa Junction.	"
39	Napa.	"	46	Napa.	20. Quaternary.
45	Oak Knoll.	"	46	Cordelia. ⁴	19. Tertiary Volcanic.
52	Oakville.	"	51	Suison. ⁵	20. Quaternary.
58	St. Helena. ⁵⁰	"			
66	Calistoga. ⁵¹	"			

1. Both sides of the straits are 18. Cretaceous.
2. Near here basalt is quarried for paving blocks.
3. Ten miles across marsh.
4. Paving blocks extensively quarried.
5. The beautiful Travertin or "Suisum Marble" found near by.

45. *White Hills.* Tunnels through these ridges are here capped by 19 b. Miocene tertiary.
46. *Freestone.* The great Red Wood forest commences here and covers most of the hills, with part of the valleys, northward near the coast, chiefly west slopes.
47. *Sonoma.* A low ridge of 18. Metamorphic Cretaceous, much broken by 19. Volcanic Tertiary, separate Sonoma, also Santa Rosa Valley.
48. *Vallejo.* No Metamorphic Cretaceous visible along the railroad, only thin bedded, unaltered strata. The fossil forest is on this route.
49. *Napa Jun. to Calistoga.* The hills on both sides are metamorphic (18. Cretaceous?), with volcanic outbursts increasing toward the northeast, and with quicksilver deposits.
50. *St. Helena.* Mt. Helena, the culminating point of the volcanic mountains, to the north and east, is 4,343 feet high.
51. *Calistoga.* Twenty-five miles north is Clear Lake, where sulphur and borax occur in abundance.
52. *Bridgeport.* Tunnel through 18. Cretaceous where fossils are found. Near here is a bed of fine argonite, called suezarcic marble.
53. *Woodland.* A branch road runs 80 miles further up the west side of the Sacramento River to Tehara, over level valley lands over 20. Quaternary.
54. *Ewing to Red Bluff.* The mountains eastward resemble those farther to the south, but with more 18. Cretaceous, some 13. Sub Carboniferous near the middle, and a vast 20. Quaternary volcanic field northward.
55. *Marysville.* Buttes in plain sight from the railway, northwest from the town.
56. *Soto.* Lunen's peak, a volcano, 40 miles east, is over 10,500 feet high; the lava beds here compel the railroad to cross the river.

Ms. Oregon Division Central Pacific R.R. Alt.		Ms Sacramento & Placerville R. R. Alt.	
0 Sacramento.	20. Quaternary.	0 Sacramento.	20. Quaternary.
8 Arcade.	"	10 Mayhew's.	"
15 Antelope. ⁷	"	22 Folsom.	1. Arch. Granite. ²⁰
18 Junction.	{ 19. Tertiary, Plio., with workable lig'e.	29 White Rock.	13. Sub-Carboniferous.
29 Lincoln.		37 Latrobe.	16. Trias., 17. Jur. ⁷⁹⁰
38 Ewing's. ⁵⁴	20. Quaternary.	42 Dugan's.	† " "
40 Wheatland.	"	48 Shingle Springs.	⁶⁰ " 1459
46 Reed's.	"	San Jose Branch.	
50 Yuba.	"	0 San Francisco.	18. Metam. Cretaceous
52 Marysville. ⁵⁵	"	4 Oakland.	20. Quaternary.
70 Gridley.	"	7 Brooklyn. ⁶¹	20. Qua., 19c. Ter. Plio.
83 Nelson.	"	12 Melrose.	"
90 Durham.	"	16 San Leandro.	"
96 Chico.	"	18 Lorenzo.	"
105 Anita.	"	27 Decoto.	"
110 Soto. ⁵⁶	"	30 Niles. ⁶²	"
122 Sesma.	"	34 Irvington. ⁶³	Tertiary, Pliocene.
123 Tehama.	"	37 Warm Springs.	"
135 Red Bluff.	19. Tertiary hills.	39 Haward's.	20. Quaternary.
170 Redding. ⁵⁷	19 b. Pliocene	42 Milpetas.	"
173 Middle Creek. ^{†58}	18 c. Cretaceous.	48 San Jose. ⁶⁴	"
180 Copley.	17. Jurassic slates.	Stockton & Visalia and Stockton & Cop- peropolis Railroads. ⁶⁵	
187 Kennett.	19. Tertiary volcanic.	0 Stockton.	20. Quaternary.
192 Morley.	{ 17. Jurassic or 16. Triassic slates (?)	6 Charleston.	"
196 Elmore.		(auriferous), with	11 Holden.
203 Smithson.	{ 19. Ter. Volcanic.	15 Peter's.	"
208 Delta.		Central Pacific Railroad. (Northern Division.)	
108 Marysville. ⁵⁵	20. Quaternary.	15 Peter's.	"
120 Honent.	"	22 Waverly. ⁶⁵	19. c. Tertiary Plio.
144 Orville. ⁵⁹	{ 19 c. Pliocene Ter- tiary, 18 c. Creta., 14. Sub-Carbon.	30 Milton.	1. Arch. Granite.
		15 Peter's.	20. Quaternary.
		20 Farmington.	"
		28 Clyde.	"
		34 Oakdale.	"

* The gravelly hills, with clay, slates and sandstone of fresh water formation, are here 200 feet thick or more, and may include the whole Tertiary age.

† This formation crosses the river near here full of marine fossils, and lies flat on edges of the slates below.

‡ Very much changed by 19. Volcanic.

57. *Redding.* Mt. Shaska, 14,440 feet high, is in view and easily ascended in summer from the end of the railroad. Fine Cretaceous fossils are found near here and also beds of fossil wood, and an abundance of excellent iron ore is found on Spring Creek, 12 miles to the northwest. The rocks from here north are much covered with 19. Tertiary volcanic fragments and ashes, but exposed by the deep cuts.

The Lava Beds. A large portion of the northeastern part of California, to the northern state line and spreading over Idaho, Oregon and Washington Territories, is covered to a depth of several hundred feet with great beds of lava and other volcanic material. The country has generally a broken surface, and is interspersed with hills and high volcanic cones, frequently cut into deep chasms by the few streams that occur in this region, and extensive caves have been found under the lava beds. This lava section has no arable lands, and it is fit only for grazing purposes. (See Note 39 on Northern Pacific Railroad.) E. W. H.

58. *Middle Creek.* Much placer mining is done, and quartz veins exist.

59. *Orville.* Tertiary leaves and Lignite, 18. Cretaceous, 14. Sub-Carboniferous fossils found near by toward the northeast.

60. *Shingle Spring.* Iron, lead and zinc occur near.

61. *Brooklyn.* Redwood Peak, 1,635 feet high, is the highest in the range opposite San Francisco. Mission Peak, 34 miles southeast, is 2,566 feet high.

62. *Niles to Haywards.* Follows the 20. Quaternary (alluvial), nearly after passing through Alameda Cañon 10 miles, traversing 19. Tertiary, 19 c. Pliocene and 19 b. Miocene, then lignitic, with little coal.

63. *Irvington.* Mountains on the east side rise to 4,443 feet, and on the west side to 3,780 feet in height.

64. *San Jose.* Alum Rock Cañon, about seven miles easterly from San Jose, is a pretty place, with Miocene fossils and a good hotel. E. W. H.

South Pacific Coast (N. G.) R. R.			Southern Pacific R. R.—Con.		
Sta.		Alt.	Sta.		Alt.
.....	San Francisco.	18. Meta. Cretaceous.	128	Chualar.	20. Quaternary. 108
6	Alameda.	20. Quaternary.	134	Gonzales.	" 127
14	W. Sanleandro.	"	143	Soledad.	" 183
24	Alverado. ⁶⁶	"	80	Gilroy. ⁷⁸	" 198
31	Moury's.	"	94	Hollister.	" 284
37	Alviso.	"	100	Tres Pinos. ⁷⁸	" 514
46	San Jose. ⁶⁴	"	99	Pajaro.	" 23
56	Los Gatos.	19. Tertiary Gravels.	101	Watsonville.	" 23
58	Alma.	18 c. Lign. & Met. Cre.	106	St. Andrew's.	19 c. Pliocene, Tert. ¹⁵⁸
62	Wright's. ⁶⁷	"	112	Aptos.	" 103
66	Glenwood.	19 b. Miocene Tertiary	116	Soguel.	" 53
73	Felton. ⁶⁸	"	120	Santa Cruz.	" 18
76	Rincon. ⁶⁹	19 c. Pliocene Tertiary			
81	Santa Cruz.	20. Quaternary.			
Southern Pacific Railroad.			Goshen Division S. P. R. R.		
0	San Francisco.	18 c. Metamorphic	0	Huron.	20. Quaternary. 267
6	San Miguel.	Cretaceous.	.....	Heinlen.	" 211
12	Baden. ⁷⁰	20. Quaternary. 89	.....	Lemoore.	" 220
17	Millbrae. ⁷¹	" 8	.....	Hanford.	" 243
21	San Mateo.	" 22	.....	Goshen.	" 273
25	Belmont.	" 31		Visalia.	"
28	Redwood City. ⁷²	" 9			
33	Menlo Park.	" 64			
38	Mountain View. ⁷³	" 73			
44	Lawrence's.	" 64			
50	San Jose. ⁶⁴	" 86			
63	Coyote.	" 251			
73	Tennant. ⁷⁴	" 327			
80	Gilroy. ⁷⁵	" 198			
83	Carnadero.	" 168			
86	Sargent's.	" 188			
96	Vega. ⁷⁶	" 57			
99	Pajaro.	" 23			
110	Castroville. ⁷⁷	" 17			
118	Salinas.	" 44			
			Central Pacific Railroad. (Amador Branch.)		
			0	Galt.	20. Quaternary.
			9	Cicero.	"
			20	Carbondale.	19 b. Pliocene, Terti.
			28	Ione. ⁷⁹	"
			Montrey Branch. ⁸⁰		
			110	Castroville. ⁷⁷	20. Quaternary. 17
			115	Martino.	" 14
			124	Del Monta.	19 c. Pliocene, Terti. 8
			125	Montrey.	1. Archæan Granite. 5

65. *Peter's to Milton.* Passing into 19. Tertiary, 19 c. Pliocene and 1. Archæan (granite) below it. About 18 miles southeast is Copperopolis, on the copper ledge, not worked on account of the low price of the metal.

66. *Alverado.* The hills on east are the same described on San Jose Branch in note.

67. *Wright's.* The east slope is entirely of this formation when ascended, the west being heavily covered by 19 b. Miocene Tertiary.

68. *Felton.* The hills to the west have a core of 1. Archæan Granite, also much 18 c. Cretaceous metamorphic limestone.

69. *Rincon.* Asphalt is common both east and west, and petroleum is obtained by bored wells.

70. *Baden.* A ridge of marine 19 c. Pliocene Tertiary, full of shells, etc., lies west of the road for five miles.

71. *Millbrae.* Metamorphic Cretaceous hills west of road, and granite (1. Archæan?) below.

72. *Redwood City.* 19 b. Miocene (Tertiary) hills come near on the west.

73. *Mountain View.* 18. Metamorphic Cretaceous hills on the west, mostly capped by 19 c. Miocene Tertiary (marine).

74. *Tennant.* The celebrated New Almaden Quicksilver Mines are not far west.

75. *Gilroy.* Some Lignitic (19 a. Eocene and later) exists to the west, but has not yet been found workable. Much 19. Tertiary on the slopes of hills around, with very fine marine fossils (19 b. Miocene and 19 c. Pliocene).

76. *Vega.* Passes through the 18. Cretaceous hills, flanked by 19. Tertiary (19 a. Miocene and 19 b. Pliocene) on the west. Some lignite in it.

77. *Castroville.* The hills to the southward are metamorphic and granitic, with 19. Tertiary on their flanks as before.

78. *Tres Pinos.* The New Idria Quicksilver mines lies 50 mile southeast in the highest part of this range of mountains, near 5,000 feet elevation. Iron, lead, silver and arsenic also occur.

79. *Ione.* Some lignite of very little value is found here.

80. *Montrey Branch* passes through a low spur of 19 b. Tertiary containing fossils, which lie upon the granite, and shows the effects of change by heat at the junction, from which the granite is supposed by some to be eruptive 19. Tertiary. Tropolite or infusorial polishing sand is common near here.

Pacific Coast Railroad.			California Southern Railroad—		
Ms.	(Near latitude 35°.)	Alt.	Ms.	Continued.	Alt.
0	Port Harford. ⁸¹	19 b. Miocene, Tertia.	116	San Jacinto.	20. Quaternary.
10	Ocean Side.	"	122	Riverside.	"
15	Steele's.	"	127	Colton.	"
22	Verde.	"	133	San Bernardino.	"
30	Los Berros.	"	Los Angeles & San Diego Railroad.		
85	Nipoma.	20. Quaternary.	0	Los Angeles. ⁸³	20. Quaternary. 151
42	Santa Maria.	"	5	Florence.	" 151
46	Lake View.	19 b. Miocene, Tertia.	.....	Downey.	" 112
55	Harris.	20. Quaternary.	.....	Norwalk.	" 93
64	Los Alamos.	"	.....	Costa.	" 84
California Southern Railroad.			27	Arnheim.	" 124
0	National City.	20. Quaternary.	.....	Orange.	" 120
4	San Diego.	19 c. Pliocene, Tertiary	84	Santa Anna.	" 125
9	Old Town.	20. Quaternary.	Los Angeles Division.		
20	Selwyn. ⁸²	19. Eocene, Tertiary.	0	Los Angeles.	20. Quaternary.
26	Cordero.	19 b. Miocene, Tertiary	18	San Monica.	"
35	Encinitas.	"	0	Los Angeles.	"
42	Stewart's.	"	5	Florence.	"
47	San Luis Rey.	20. Quaternary.	10	Compton.	"
52	Ysidora.	18 c. Metam. Creta.	15	Cerritos.	"
60	De Luz.	1. Archæan Granite.	22	Wilmington. ⁸⁴	"
66	Fallbrook.	"	25	San Pedro.	"
78	Temecula.	20. Quaternary.			
86	" Car B."	"			
96	Elsinore.	"			
104	Pinacate. ⁸⁵	"			

There are several short lines in different parts of California, which traverse Quaternary strata, but they show nothing beyond what is contained in these notes.

81. *Port Harford.* A branch runs northeast of San Luis Obispo, nine miles over rolling table land 19. Tertiary and 20. Quaternary; beds of enormous fossil oyster and other shells are common near by; also lignite and petroleum; volcanic and metamorphic hills also lie near, containing quicksilver. Limestone, etc., is further north.

82. *Selwyn.* Fossils are numerous in the nearly level strata near the coast and probably include all the 19. Tertiary divisions. Under these, at Pt. Loma, 18. Cretaceous fossils are found with lignite in up-tilted strata, and the bed near Selwyn was confounded with these and described as Cretaceous, Division B., at first, but agrees better with the Tertiary. The true Cretaceous again occurs on the west slope of the Santa Anna Coast Mountains, five miles north of Fall Brook station. Fine felspar, tourmaline and garnets also occur in this range in granite.

83. *Pinacate.* A few miles north of the Tamesca Mountains are the tin mines, which will probably become of much value, going up to 60 per cent.

84. *Wilmington.* A metamorphic (18. Cretaceous) hill north of this harbor. The islands visible are similar, with some 20. Quaternary sandstone and Paleozoic rocks.

85. *Goshen to Caliente.* The mountains westward are like those from Pleasanton to Niles, with more 19. Tertiary, 19 b. Miocene and 18. Cretaceous. Also 20. Quaternary, volcanic and granite in places. The only coal now worked is north of Mt. Diablo and south of Livermore. The granite, of the coast ranges at least, is eruptive, and belongs rather to the Quaternary than the Archæan.

86. *Stockton & Visalia Railroad.* The most northern group of "Big Trees" is approached by this route.

The Big Trees. One of the greatest curiosities in California consists of the Big Tree Grove, situated on the divide between the middle fork of the Stanislaus and the Calaveras rivers, about 20 miles east of Mokelumne hill, and at an elevation of 4,750 feet above the level of the sea. The trees range in height from 150 to 327 feet, and in diameter from 15 to 30 feet.

87. *Pems Grove to Santa Rosa.* The foothills are full of Tertiary fossils (Miocene and Pliocene). The metamorphic and volcanic mountains contain valuable quicksilver mines.

88. *Northern Pacific Coast Railroad.* The only groves of celebrated "Redwood" tree, accessible by railroad, are on this route and northward.

Errata:—Note 6, for "telburet" read telluret; page 320, at Cornwall and Antioch, read Pliocene; at Brentwood, etc., Quaternary; at Banta, for 19 a. "Miocene" read Eocene; page 321, at Nadeau, Quaternary; Note 28, for "El Carco," El Casco; page 324, for "Fem's Grove," Penn's Grove; Note 41, for "intermixed," intermixed; for "quarts," quartz; Note 43, after sulphur place a semicolon; page 325, for "Buricio," Benicio; "Vancieu," Vancieu; 327, "St. Andrews," San Andrews; Note 50, for "Tropolite," Tripolite; page 328, "San Monica," Santa Monica; throughout the chapter for "Central," read Southern Pacific.

Delaware.*

GEOLOGICAL FORMATIONS OF DELAWARE.**

GROUPS.	DELAWARE SUB-DIVISIONS.	
20. QUATERNARY.	{ Post Glacial. Glacial.	{ Bog Clay, River Shore, 20 c. Brick Clay, 20 b. Red Gravel and Estuary Sands, 20 a.
19. TERTIARY.	{ 19 c. Pliocene. 19 b. Miocene.	{ Blue Clay, 19 c. Glass Sand, 19 c. Potters Clay, 19 b.
18. CRETACEOUS.	{ 18 c. Upper Cretaceous. 18 b. Middle Cretaceous. 18 a. Lower Cretaceous.	Green Sand, 18 c. Sand Marl, 18 b. Wealden Clays, 18 a.
	Crystalline Rocks. Age undetermined.	Eruptive Gabbros and Horn- blende Rocks. Philadelphia Gneiss. Magnesian Marble. Quartzite.

Philadelphia, Wilmington, and Baltimore R. R.			Newark and Delaware City Rail- road—Continued.		
Ms.	STATIONS.	GEOLOGICAL FORMATIONS.	Ms.	STATIONS.	GEOLOGICAL FORMATIONS.
0	Philadelphia.	Phila. Gneiss, 20	8	Corbitt.	Middle Cretaceous. 18 b. (Sand Marl.)
19	Claymont.	Gabbros, 14	10	Reybold.	"
22	Bellevue.	"	12	Delaware City.	{ 18 b & c. Middle & Up. Cre. Sand Marl & Green Sand Marl.
24	Edge Moor.	18 a. L. Cre. & Gab.			
26	Wilmington. ⁴	" 7			
32	Newport.	" 21			
34	Stanton.	" 17			
40	Newark. ¹	" 10			
Newark and Delaware City R. R.			Pennsylvania & Delaware R. R.		
Ms.	STATIONS.	GEOLOGICAL FORMATIONS.	Ms.	STATIONS.	GEOLOGICAL FORMATIONS.
0	Newark. ¹	L. Cretaceous, 100 18 a. (Plastic Clays.)	0	Newark. ¹	{ 18 a. L. Cretaceous Amphibolites and Phila. Gneiss. 100
2	Wilson. ²	"	8	Landenberg. ²¹	{ Quartzite, Marble, and Philadelphia Gneiss.
3	Cooche.	Plastic Clays & Trap.	11	Avondale.	(See Pennsylvania.)
4	Keeney.	"	26	Pomeroy.	"
5	Glasgow.	"			
6	Porter's.	"			

* By Prof. Fred'k D. Chester, of Delaware State College, Newark, Delaware.

Delaware Railway.			Delaware, Maryland & Virginia Railroad.		
Ms.	STATIONS.	GEOLOGICAL FORMATIONS.	Ms.	STATIONS.	GEOLOGICAL FORMATIONS.
0	Wilmington.*	18 a. L. Cre. & Gab.	0	Harrington.	19 c. U. Pl. to P. Pl.
6	New Castle.*	18 a. L. Cre. (Pl. Cl.)	9	Milford.	" "
16	Kirkwood.	18 b. Cre. (Sand Marl).	12	Lincoln.	" "
21	Mt. Pleasant.*	18 c. U. C. (Ind Marl).	17	Ellendale.	" "
25	Middletown.	18 c. U. C. (Gr. S'd). ⁶⁶	25	Georgetown.	" "
29	Townsend.	19 b. Mio. (Pot. Cl.). ⁷¹	25	Georgetown.	" "
37	Clayton.	" "	31	Harbeson.	" "
39	Smyrna.*	" "	38	Cool Spring.	19 c. U. Pl. to P. Pl.
48	Dover.*	" "	86	Nassau.	" "
51	Wyoming.	" "	40	Lewes.	20 c. Modern.
56	Viola.	" "	25	Georgetown.	19 c. U. Pl. to P. Pl. ⁷¹
58	Felton.	" "	41	Frankfort.	" "
64	Harrington.	19 c. U. Pl. to P. Pl. ⁶⁶	54	Berlin.	" "
68	Farmington.	" "	68	Snow Hill, Md.	" "
76	Bridgeville.	" "	77	Stockton.	" "
84	Seaford.*	" "	81	Franklin.	" "
90	Laurel.	" "			
97	Delmar.	" "			

NOTES ON DELAWARE.

1. *Newark.* On the plane to the south of Newark, red and white (mottled) clays rise a few feet above the surface, covered by a great thickness of Red Gravel and brick clay of Quaternary age. The mottled clays are probably the equivalent of the Wealden, the latter sub-division being referred by most authors to the Lower Cretaceous, and by a few to the Upper Jurassic. Passing to the north of the town, you walk for a mile over a belt of Amphibole trap, beyond which are soft mica schists and granitic gneisses of doubtful Palaeozoic age. Hills from the background of the town, along the slopes of which can be traced the terrace of Quaternary gravel.

2. *Wilson.* Iron Hill is three miles long by one mile wide, the back bone being a mass of dioritic trap and jaspery quartz. The trap is decomposed into a serpentinic earth, which is completely impregnated with masses of limonite. Several iron ore pits are at present wrought. This dike is entirely confined to the area of Wealden clays, but was evidently an island when the latter clays were deposited, or at least of an earlier origin than the clays.

3. *Delaware City.* At this place a yellow sand marl is succeeded by a calcareous Green Sand of an ashy color. This can be seen well exposed along the level of the canal, particularly near St. George's.

4. *Wilmington.* Excellent exposures of Eruptive rocks are obtained along the Brandywine, consisting of alternate masses of syenitic gneiss, with a predominance of a coarse feldspathic Hypersthene Gabbro.

5. *New Castle.* One mile south of New Castle, upon the river, is a bluff of white, sandy fire clay. This is the only exposure in the State of the lowest member of the Plastic Clay Series, and is overlaid by 50 feet of mottled clays.

6. *Mt. Pleasant.* Two miles to the northwest of this station is the deep cut made by the canal. For nearly two miles the green sand rises as high banks upon each side, offering the best exposures of the marl in the State.

7. *Smyrna.* The Miocene clays are well exposed along Duck Creek, and abound in places in characteristic fossils.

8. *Dover.* The Miocene clays can be seen back of the town on Jones Creek, and a little to the south on Murderkill Creek. Miocene fossils are found in abundance.

9. *Seaford.* To the east of Seaford, upon Nanticoke River, a dark blue clay is well exposed. At its junction with the overlying loam are found nests of the modern Oyster. This blue clay is found to cover all of Sussex County, but is rarely seen, except in the deeper cuttings of the creeks. Its thickness varies from three to ten feet, beneath which is over forty feet of fine glass sand. The glass sand is probably the equivalent of the New Jersey glass sand of Pliocene age. The modern shells, although found at the junction of the Blue clay with the overlying gravel, are more imbedded in the latter. I therefore regard the gravels as early Quaternary, and the Blue clay as later Pliocene.

10. *Hockessin.* At this place are excellent quarries of pure dolomitic marble. Kaolin is also worked in abundance. The dolomite beds in Jackson's quarry form a perfect anticlinal, overlaid by a corresponding anticlinal of Mica schist. This dolomitic area is the extremity of a tongue of the same rock extending in from Pennsylvania.

11. *Landenberg.* Near this place in the limestone quarries the relation of the Potsdam quartzite, calciferous marbles and mica schists to each other can be well studied; there are seen three anticlinals capping each other, with the mica schists uppermost.

12. The northern part of the State of Delaware is underlaid by Crystalline rocks, which extend from the northern curved boundary of the State to a line crossing the State a little north of the Philadelphia, Wilmington and Baltimore Railroad, and running in the same direction about N. 50° E. The latter area is divided into two belts of about equal extent.

(a) A southern club-shaped area, composed of amphibolite schists, with which is associated a bluish gray trap, ranging from a quartz diorite to a true hyperite. This area is a continuation of the

Wilmington & Northern R. R.			Wilmington & Western R. R.		
Ms.	STATIONS.	GEOLOGICAL FORMATIONS.	Ms.	STATIONS.	GEOLOGICAL FORMATIONS.
0	Reading, Pa.	See Pennsylvania.	0	Wilmington.*	Gabbro. & 18 a. L. C.
57	Chadd's Ford.	Phila. Gneiss.	7	Greenbank.	Phila. Gneiss.
61	Granogue.	"	12	Ashland.	"
63	Adams.	Hypersthene Gab. ***	15	Hockessin. ¹⁰	" with Marble.
65	Dupont.	" ***	17	Southwood.	{ Quartzite, Marble,
66	Greenville.	"	20	Landenberg. ¹¹	and Mica Schists.
68	Lancaster R'd.	"			Same as above.
72	Wilmington. ⁴	L. Cre. & Gabbro. "			

syenitic areas of southeastern Pennsylvania, referred by Mr. C. E. Hall to the Laurentian, although they may prove to be Huronian, or even later, and probably forms an intrusive mass between the Philadelphia gneiss.

(2) A northern area, the shape of a double convex lens, covered by granitic gneisses and mica schists, the equivalent of the Philadelphia gneiss, which by earlier writers has been referred to the Montalban, and by later to the Palaeozoic.

This part of the State has an uneven surface of beautifully rounded hills, with a bold and rounded outline, and is elevated several hundred feet above tide water. Limestone also occurs in this primary region. It is a nearly pure dolomite in a coarse and fine grained crystalline mass of a white color, with at times a bluish tinge. About six miles N. W. of Wilmington is a limited body of serpentine of various shades of green, with a heavy vein of granite passing through it.

South of the Primary or Rocky regions of the State and, indeed, from its lower limit to the southern boundary of Delaware, the general features of the country are widely different. Instead of a constant succession of irregular and boldly rounded hills, is presented a comparatively level country or table land, gently sloping east and west towards either bay from an elevated strip of land several miles in breadth. The streams flow from this east and west through the soft and yielding strata which constitute the geological formations of a very large portion of the State; these formations being composed of clays and sands which are more or less loose in their texture. The surface of the country, originally rather flat and level, has been scooped out by brooks and creeks and rain torrents into an undulating surface, presenting low hills and bowl-like depressions, sometimes gently sloping, at others with abrupt declivities, where the formations offer a sufficient resistance to the agents of denudation. From the lower limit of the primary formation nearly to the southern border of New Castle County, is a series of clays and marls of the Cretaceous and upper Jurassic formations. Between the lower or southern limit of the Cretaceous and the lower part of Kent County exists a series of beds of clay and sand which are of the tertiary (miocene) formation. The surface of the country in the lower part of Kent and the whole of Sussex County is much more level than that farther north. The aggregate thickness of all the formations south of the primary will probably not fall short of five hundred feet, and the general bearing of all the formations, like that of the primary, is nearly N. 50° E.

The little State of Delaware furnishes us with a general description of the Geology of the whole Atlantic Coast, including considerable portions of the States of New Jersey, Maryland, Virginia, North and South Carolina and Georgia, comprising the primitive Archæan backbone or foundation formation, with the Cretaceous, Tertiary and Quaternary extending eastward from it to the Ocean.

Eastern Shore of Maryland and Virginia.*

New York, Phila. & Norfolk R. R.			Wicomico and Pocomoke R. R.		
0	Delmar, Del.	19 c. U. Pl. to P. Pl. ²³	0	Salisbury.	19 c. U. Pl. to P. Pl.
6	Salisbury, Md.	"	10	Pittsville.	20 c. P. Pl. & Modern
10	Fruitland.	20 c. Modern.	19	St. Martin's.	" "
19	Princess Anne.	"	23	Berlin.	" "
22	King's Creek.	"	30	Ocean City.	" Ocean Sand.
			Baltimore and Del. Bay R. R.		
28	Kingston.	20 c. Modern.	0	Clayton, Del.	19 b. Miocene.
88	Crisfield.	" Salt Marsh.	20	Kennedyville.	19 a. Eocene.
72	Exmore.	20 c. Modern.	31	Chestertown.	"
95	Cape Charles.	" Ocean Sand.	86	Parsons.	19 a. Eocene & Creta.
119	Old Pt. Comfort	By Steamer.	Queen Anne's & Kent & Townsend.		
181	Norfolk.	"	0	Townsend.	19 b. Miocene.
Cambridge and Seaford R. R.			18	Sudlersville.	"
0	Seaford, "	19 c. U. Pl. to P. Pl.	35	Centreville.	"
14	Williamsburg.	"	Delaware and Chesapeake R. R.		
88	Cambridge.	"	0	Clayton, Del.	19 b. Miocene.
			14	Marydell.	"
			32	Queen Anne.	"
			41	Easton.	"
			51	Oxford.	"

* That is the Eastern Shore of Chesapeake Bay in those States.

Maryland.*

Philadelphia, Wilmington and Baltimore Railroad.			Baltimore and Ohio Railroad. Washington Branch.		
Ms.	STATIONS.	GEOLOGICAL FORMATIONS.	Ms.	STATIONS.	GEOLOGICAL FORMATIONS.
0	Philadelphia.	(See Pennsylvania.)	0	{ Baltimore. ⁷ Camd'n Stat.	17. Jurassic.
28	Wilmington.	18. Cret. & 17. Juras. ⁷	9	Relay House. ⁸	1 b. Hur., Intru. Gran.
30	Delaware Junc.	"	19	Annapolis Jun.	17. Jurassic.
32	Newport.	"	22	Laurel.	" & Dior. Hur.
34	Stanton.	"	28	Beltsville.	"
40	Newark.	"	34	Alex'ndria Jun.	"
46	Elkton.	"	34	Bladensburg.	"
52	Northeast. ¹	1. Azoi.	40	Washington. ⁸	" 1 b. Huron'n.
55	Charlestown.	1. Azoi.			
61	Perryville.	17. Juras. & Archæan ¹¹ (Susquehanna River.)	Alexandria Branch.		
62	Havre-de-Gr'ce	{ 1. Granite, Gabbro- Diorite, 17. Jur. ¹⁰	0	Baltimore.	(As before.)
67	Aberdeen.	17. Jurassic.	84	Alexandria Jc.	17. Jurassic.
74	Bush River.	"	40	Banning's.	"
77	Edgewood.	"	42	Uniontown.	"
79	Magnolia.	"	46	Shepherd.	Cretaceous & Juras.
89	Stemmer's Run	"	Annapolis and Elk Ridge R. R.		
94	Bay View.	"	0	Annapolis Jc.	19. Cret. & 17. Juras.
98	Baltimore.	"	8	Patuxent.	"
Phil. and Baltimore Central R. R.			6	Odenton.	17. Jurassic.
0	Philadelphia.	(See Pennsylvania.)	9	Gambrill's.	"
36	Kennett.	"	10	Millersville.	Cretaceous.
52	Oxford.	"	12	Waterbury.	"
60	Rising Sun.	1 a. Laure'n, Serpent.	14	Crownsville.	"
67	Rowlandville.	"	16	Iglehart.	" & 19 a. Eocene
71	Port Deposit. ⁸	" Granite.	18	Camp Parole.	Eocene.
75	Perryville.	17. Jurassic & Archæ.	21	Annapolis. ¹	{ Eocene.
112	Baltimore. ⁷	"	Northern Central Railroad.		
Baltimore and Potomac Railroad.			0	Baltimore.	{ 17. Jurassic and 1 b. Huronian.
0	Baltimore. ⁷	17. Jur. & 1 b. Huro'n	2	Mt. Vernon.	"
19	Odenton. ⁸	18. Cret. and recent.	7	{ Green Spr'gs Junction. ⁴	{ 2-4. Siluro-C'mbr'n Serpentine.
21	Patuxent.	"	12	Timonium.	"
26	Bowie.	"	15	Cockeysville.	{ " large quar- ries of white marble 11 c. Montalban.
34	Wilson's.	" 18. Cret. n'r	20	Sparks'.	{ 2-4. Siluro-C'mbr'n Limestones.
41	Navy Yard. ⁸	"	23	Monkton.	Hur'n & Mica Schists.
43	Wash., D. C.	"	29	Parkton.	{ 1 c. Montalban and Serpentine.
Pope's Creek Branch.			85	Freeland's.	1 c. Montalban.
0	Baltimore. ⁷	"	42	Glenrock.	"
26	Bowie.	17. Jurassic.	47	Hanov. Ju., Pa.	2-4. Siluro-Cam.
40	Marlboro.	Upper Eocene.	57	York, Pa.	"
46	Linden.	19 a. Eocene.			
51	Brandywine.	19 b. Miocene.			
65	La Plata.	"			
69	Cox.	"			
75	Pope's Creek.	"			

* By Prof. P. R. Uhler, of the Peabody Institute, Baltimore, except B. & O. R. R. west.

1. Kaolin occurs near Annapolis, near Northeast, and near the Metropolitan Railroad in Montgomery County.

Western Maryland Railroad.*			Baltimore & Ohio R. R.—Continued.		
Ms.	STATIONS.	GEOLOGICAL FORMATIONS.	Ms.	STATIONS.	GEOLOGICAL FORMATIONS.
0	Baltimore. ⁷	17. Jurassic & 1 b. Huronian.	62	Frederick.	1 b. Hur. limestone.
3	Fulton Station.	"	69	Point of Rocks	16. Trias. Pot. marb.
5	Oakland. ³⁸⁰	"	0	Washington. ⁹	17. Up. Jur.? & Azoic.
6	Arlington. ⁴²⁰	"	7	Sil'r Spring. ³²⁰	"
9	Ho'rdsville. ⁴²⁰	"	11	Knowles'. ³²⁰	"
10	Pikesville. ⁴²⁰	" Ser. Mo. n'r.	16	Rockville. ⁴²¹	1 b. Hur. & 1 c. Mont.
11	Greenwood. ⁴²⁰	"	22	Gaithersb'g. ⁴²²	" Serpentine.
14	Owing's Ms. ⁴²⁰	"	27	Germant'n. ⁴²²	"
19	Reisterstown.	" & Montalb'n.	29	Boyd's. ⁴²⁰	" Tal. sc. Mon.
22	Finksburg.	Montalban. Copper.	33	Barnesville. ³⁰⁰	"
31	Tannery. ⁶¹⁰	Huronian.	36	Dickerson's. ³²⁰	16. Tri. n. Dia. dykes
34	Westm'ster. ⁷⁰⁰	" Marble.	43	Pt of Rocks. ³²⁰	" Poto. Marble.
41	N. Windsor. ⁴⁴⁰	" Var. Marble.	69	Point of Rocks.	16. Trias. Pot. Marb.
45	Un. Bridge. ³⁸⁰	Trias. & Silur.-Cam.	75	Berlin.	1 b. Huronian?
48	Middleb'rg. ⁴¹⁵	Triassic, Var. Marble.	79	Weverton. ³⁴⁰	Montalban.
49	Frederick Jc. ⁴¹⁵	16. Triassic.	90	Sandy Hook.	"
54	Rocky Ridge.	" Diabase.	81	Harper's F'y. ⁷⁷	Potsdam and Slate.
61	Emmitsburg.	16. Tri. Diab. dyke.	87	Duffield's, Va.	3a. to 4 c. Sil.-Cam. l.s.
59	Mech'cst'n. ⁵³⁰	2 b. Potsd. (Marble.)	92	Kearneysville.	"
69	Blue Ridge. ¹³⁷³	"	95	Vanclievesv'le.	"
82	Waynesboro.	Slate "	100	Martinsb'g. ⁴²²	"
77	Smithsburg. ⁷⁸⁰	4 a. Trent. limestone.	107	Nor. Mount. ¹⁹	5-12 Sil. & Devonian.
86	Hagersto'n. ⁸²⁰	"	117	Sleepy Cr'k. ⁴¹⁰	"
93	W'msport. ³⁰⁰	4 c. Hudson River.	122	Hancock. ⁴²⁰	10 Ham. & 7 L. Held.
106	Martinsburg.	3 a. & 4 c. Cal. & Hud.	128	Sir John's Run.	8-12 Devon. ⁴²²
Baltimore and Ohio Railroad.*			133	Orleans Road.	"
0	Baltimore. ⁷	17.	153	Paw Paw.	"
15	Ellicott City. ⁸	1 a. Lau., Gran. quar.	163	Green Spring.	7. L. Hel. & 8 Ori
20	Elysville. ⁸	"	170	Patterson's Ck.	10. Hamilton.
25	Woodstock. ⁸	"Gra. & Stea. qu.	178	Cumbl'd, Md. ¹⁴	{ 8. Oriskany. 7. Lower Held'g to 13 a. Vespertine. ⁴²⁰
27	Marriottsville.	1 b. Huronian?			
32	Sykesville. ⁴¹⁰	"			
43	Mt. Airy. ⁴¹⁰	1 c. Montalban.			
50	Monrovia.	" Slate quar.			
58	Frederick Junc.	" Trias. near.			

2. Hartford County, a few miles northwest of the Philadelphia, Wilmington & Baltimore Railroad yields a fine green serpentine in blocks, equal to verd-antique in splendor and polish, besides the common building sort. In the Jurassic beds on the same railroad, also on the Washington branch of the Baltimore and Ohio Railroad, vast beds of nodular carbonates of iron occur, rich in metal.

3. The Woodstock, Ellicott's City and Port Deposit granites are superior of their kind.

4. Bare Hills mineral region. It has chrome and copper ores, asbestos, serpentine and magnesium rocks.

5. The Western Maryland Railroad runs near copper mines, chrome, serpentine, talc, steatite, asbestos, carbonate of iron, and most beautiful marbles of every color, from black, dark red, salmon, etc., to pure white—even statuary marble—besides the breccias of every degree of size in their component pebbles or pieces, both round and angular. P. R. U.

6. By Prof. William M. Fontaine, of Morgantown, West Virginia.

7. Baltimore is located upon rocks of 1 b. Huronian and 1 c. Montalban ages and upon clays and sands which rest upon the eroded edges of both of these. The clays approach the neocomian in position, while the sands and drifts belong to various more recent horizons. P. R. U.

8. The rocks of the eastern portion of the Azoic area in Maryland, as in Virginia, are granites, gneisses and hornblende rocks. This belt extends to near Parr's Ridge, where it is succeeded by Argillitea, with some metamorphic limestone, probably of Montalban age.

9. The Azoic area passes some distance to the west of the railroad from Baltimore to Washington, consequently this road runs chiefly in formations similar to those found at Baltimore. Washington has a geological position similar to that of Baltimore, but here the subjacent rocks are plainly similar in age to the Fredericksburg sandstones, and are probably Upper Jurassic.

10. On the west side of the Monocacy River a belt of Mesozoic rocks occurs, extending to near the east base of the Catoctin Range. Along the west margin of this belt occurs the remarkable line-

Cumberland & Pennsylvania R. R.			Cumberland and Pennsylvania Railroad.—Continued.		
Ms.	STATIONS.	GEOLOGICAL FORMATIONS.	Ms.	STATIONS.	GEOLOGICAL FORMATIONS.
0	Cumberland. ¹⁴	10. Hamilton. ^{***}	12	Morantown.	14 c. Up. Coal Mres.
		8. Oriskany.	17	Frostburg. ¹⁰	1000 " "
		7. Low. Helderb'g	20	Borden Shaft.	1000 " "
	to	5 b. Clinton.	22	Ocean Mines.	1000 " "
		5 a. Medina.	25	Jackson.	1000 " "
		5 a. Oneida.	29	Barton.	1000 " "
2	Will's Gap.	4 c. Hudson Riv.	24	Pi'dm't, W. V.	1000 " "
4	C. & P. Junc.				
7	Patterson's. ¹⁵	4 c. up to 14 b. Low.			
8	Barrelville.	Coal Measures.			
10	Mt. Savage.	1000			

The great
Cumberland
coal region—
Coal bed 14
feet thick.

Geology of the Vicinity of Baltimore.*

Northern Central Railroad.			Western Maryland Railroad.		
Ms.	STATIONS.	GEOLOGICAL FORMATIONS.	Ms.	STATIONS.	GEOLOGICAL FORMATIONS.
0	Baltimore. ¹¹	Hornbl. sch. Gn. age?	0	Baltimore.	Hornblen. schist age?
3	Woodberry.	Gneiss	3	Fulton Station.	Decomp. Mica sch.
5	Melvale. ¹⁰	" "	4	Highland Park.	Hypersth. Gabbro
6	Mt. Wash'ton.	" "	5	Oakland.	" "
7	Hollins. ¹⁰	" "	6	Arlington.	" "
14	Texas.	Crys. l. s. Marb.	8	Mt. Hope.	" "
15	Cockeysville.	" "	9	Howardsv'le. ¹⁰	" "
			10	Pikesville.	Mica schist
			12	McDonough.	Gneiss
				etc.,	etc., etc.

stone breccia called the Potomac Marble. This is well exposed near Point of Rocks. This Mesozoic belt is flanked immediately on the northeast and east by a belt of rather impure slaty limestone.

11. The gorge at Harper's Ferry is cut through metamorphic rocks, of in part probably Huronian age. One and a half miles west of the station the Calciferous limestone appears. From this point, 63 miles, to near North Mountain, 107 miles, a wide belt of Lower Silurian limestone occurs, with occasional bands of slate, embracing the rocks from the 3 a. Calciferous to and including the 4 c. Hudson River. These have never been separated in this region. The limestone predominates by far, and will be spoken of as the 2-4. Siluro-Cambrian.

12. On the west side of this limestone belt, a great fault brings down in North Mountain the various Silurian and Devonian formations from the 5 a. Medina to the 13 a. Vespertine or No. X, which are to be seen in North Mountain and its immediate vicinity.

13. From North Mountain to Cumberland a wide belt of highly disturbed strata occurs. Owing to the close compression of the folds in which the strata are thrown, many of the formations contained in this belt are always to be seen at any given locality, and hence when any formation is given for a station it must not be inferred that this alone occurs there.

In this belt the following formations are to be found: The 5 a. Oneida, 5 b. Clinton, 7. Lower Helderberg, 8. Oriskany, 10. Hamilton, 11 a. Portage, 11 b. Chemung, 12. Catskill, and 13 a. Vespertine. These have never been clearly separated from each other. The hard sandstones, such as the 5 a. Oneida and 8. Oriskany, usually form the crests of the ridges, and the softer strata, more commonly the Hamilton, compose the valleys and foot hills. W. M. F.

14. *Cumberland, Md.* Beautiful Oriskany sandstone fossils occur at the quarries in and about the city. Also Lower Helderberg and Clinton group fossils on Wills Creek below the town and Wills Gap. Also Fucoids of the Medina sandstone. R. P. WHITEFIELD.

15. *Patterson Creek.* A short distance south of the road good Hamilton fossils are obtained on the Patterson farm. R. P. W.

16. *Frostburg.* Coal plants of various kinds, Hamilton fossils as casts occur in and on the hills on the N. E. of the city, some of them very fine. R. P. W.

*As it would seem advisable to give with some fullness what is known about the rocks near a large city like Baltimore, the following notes on the crystalline rocks in that neighborhood have been furnished for this book by Dr. George H. Williams, associate in Mineralogy at the Johns Hopkins University, in which he has brought to light some interesting points which are easy of access. J. M.

Baltimore & Ohio Railroad.			Maryland Central (Delta) R. R.		
Ms.	STATIONS.	GEOLOGICAL FORMATIONS.	Ms.	STATIONS.	GEOLOGICAL FORMATIONS.
9	Relay.	{ Granite & Granitoid Gneiss, age?	0	Baltimore.	Gneiss quarries age?
10	Avalon.	Gn. & Horn. sch. "	2	Guilford.	Gn. & Horn. sch. "
11	Or'ge Grove. ²¹	{ Gneiss with Erupt. Gran. Dykes age?	7	Towsontown.	Gneiss "
12	Ilchester.	Hornblend. Gn. "	11	Loch Raven. ²⁴	{ Mica sch., Quartzite & Crys. limest'ne
14	Grays.	Gneiss "	18	Notch Cliff.	
15	Ellicott City. ²²	Granite "	27	Belair.	
20	Elysville.	Gneiss & Granite "	24	Fern Cliff.	
23	Woodstock. ²³	Gneiss "	36	The Rocks.	
			44	Delta.	

17. On the outskirts of the city on the right are the large Gneiss quarries of Jones Falls, which furnish Baltimore with much building and paving stone. They also produce many beautiful minerals, including the species Beaumontite (Heulandite) and Haydenite (Chabazite). The Gneiss is intersected by large veins of pegmatite containing fine specimens of microcline and frequently tourmaline, apatite, sphene, garnet, etc.

18. Between Melvale and Woodberry a tongue of the Hypersthene-gabbro is crossed, and a contact between this rock and the gneiss well exposed.

19. Just west of Hollins Station, but not visible from the railroad, is the lenticular mass of serpentine, known as the Bare Hills. It contains considerable chromite, which, however, is now no longer worked. Just south of the Bare Hills is a mine of chalcopryite, occurring in the hornblende gneiss in connection with octahedral crystals of magnetite, and an interesting monoclinic variety of anthophyllite. G. H. W.

20. This most interesting eruptive rock, locally known as "Niggerhead," covers an area of about fifty square miles west and north-west of Baltimore. It is most admirably exposed at the above-named stations, especially at Mt. Hope, where a long cut reveals a section of it over 1,000 feet in length. In general appearance it strongly resembles the normal triassic trap, but is petrographically altogether different. It weathers to a dark vermilion soil, through which huge blocks of the fresh purple rock may be seen protruding. The most interesting feature of this gabbro is the partial alteration which it has suffered to a hornblende rock which is generally massive, although sometimes schistose. This may be designated as Gabbro-Diorite, and has been formed by the paramorphosis of the pyroxene to hornblende without chemical change (see Am. Jour. Sci., Oct., 1894). This change may be most advantageously studied at the Mt. Hope cutting. Just south of Highland Park the contact of the Gabbro and Schists may be seen with large dykes of the former rock alternating with the schists before the actual contact is reached. G. H. W.

21. A few hundred yards above Orange Grove, on the Patapsco River, there is a most interesting profile 250 feet in length exposed by the railroad excavations. Hornblende schists, dipping over 70° to the west, are cut by apparently eruptive granite. In the center a huge trunk, nearly 30 feet broad, emerges from the ground parallel to the dip of the schists, and from this two lateral arms are given off on each side which traverse the schists nearly at right angles to their bedding. The lower of these lateral arms on the west side, although only four feet broad at its origin, may be traced over 150 feet in a horizontal direction, and when it disappears is less than five inches in width. On the east side the arms are equally well marked, but are not exposed for so long a distance. Inclusions of the schist in the granite are very numerous; one in the main trunk is over 14 feet long. These dykes exhibit in an admirable manner the effect of the cooling surface on their structure, being always very coarse grained in the center but fine grained at the edge. Smaller dykes of granite are frequently exposed between Orange Grove and Avalon. G. H. W.

22. The granite at Ellicott City is generally porphyritic; on the edges of the mass, however, this structure disappears and the rock seems to pass gradually into Gneiss. G. H. W.

23. The granite extensively quarried at Fox Rock and Granite P. O., a few miles north of Woodstock, is of a very superior quality, closely resembling the "Richmond Granite" of Virginia. G. H. W.

24. Loch Raven is a romantic spot on the Gunpowder River, which has been dammed as part of the Baltimore water supply. A conduit, cut through five miles of solid rock, leads the water to the city. From the station northward along the river the road exposes a fine section of quartzite and mica schist in contact with crystalline limestone. On the railroad are exposed quartz rocks and gneisses, with tourmaline and secondary mica developed on the cleavage planes. These are immediately overlaid by crystalline limestone, which is in turn succeeded by mica schists, often rich in garnet and fibrolite, and resembling the well known Philadelphia mica schists. At many points, however, the rocks on both sides of the limestone appear to be identical. At the upper contact is a huge dyke of very coarse grained granite. This is on the road just opposite the Water-works building on the dam. G. H. W.

This blank space is intended for additional geological notes in pencil by the traveler.

West Virginia.¹

TABLE OF GEOLOGICAL FORMATIONS IN WEST VIRGINIA.

Carboniferous.	20. Quaternary, Glacial dam and river deposit			Devonian.	10 c. Genesee	150-200	VIII.
	15. Permian or Permo Carboniferous	1,500	XVI.		10 b. Hamilton	600-800	VIII.
					10 a. Marcellus	500-600	VIII.
	14 c. Upper Coal Measures	275-374	XV.	Upper Silurian.	8. Oriskany	75-150	VII.
14 b. Barren Measures	585-800	XIV.	7. Lower Helderberg		400-500	VI.	
14 b. Lower Coal Measures	250-1,100	XIII.	6. Salina		800-900	V.	
14 a. Pottsville Conglomerate and New River Coal Series	150-1,300	XII.	5 b. and c. Niagara (?) and Clinton		400-500	V.	
				5 e. Medina and Oneida	1,400-2,000	IV.	
Sub Carboniferous.	13 c. Mauch Chunk Shales	300-2,000	XI.	Lower Silurian.	4 c. Hudson River	2,000-3,000	III.
	13 b. Mt. or Green Brier L. S.	100-800	XI.		4 a. Shenandoah L. S.	4,000-5,000	III and II.
	13 a. Pocono S. S.	500-1,200	X.		2 b. Potsdam	2,000-3,000	I.
Devonian.	12. Catskill	800-1,500	IX.	Archaean.	1 b. Huronian		
	11-12 Chemung-Catskill	800-1,000	VIII.				
	11 b. Chemung and	2,500	VIII.				
	11 a. Portage						

DESCRIPTION OF THE GEOLOGICAL FORMATIONS.

As the descriptions of the formations given in the introductory part of this volume do not give a detailed account of the carboniferous rocks, and as West Virginia can lay claim to greater development of these beds than any other State, Professor I. C. White has kindly furnished the following resumé of their structure and characteristics, and has extended it briefly to the other formations of that State, besides the Carboniferous. As these are the results of Professor White's very recent explorations as United States Geologist, they will be especially valuable to those who have not the time or opportunity to look through the official geological reports, and they may serve to correct many erroneous statements as to the geology of West Virginia which have obtained currency.

J. M.

20. QUATERNARY. Cincinnati Ice Dam and Flooded River epochs.

The only Quaternary deposits found in West Virginia are those made along the Ohio River and its tributaries during the existence of the Glacial dam at Cincinnati, and those made along all the streams which drain the Allegheny Mountains plateau. (See Note 62.) The rounded boulders at high levels along the Potomac, Cheat and other rivers resemble glacial deposits, but no glacier ever existed in West Virginia, the deposits in question having been made during the "Flooded River" epoch which closed the glacial period, when the snows that had doubtless accumulated to a considerable thickness on the Allegheny plateau melting away filled the draining streams with water to a depth probably exceeding 100 feet. The entire area of West Virginia was elevated above sea level during the Appalachian revolution, and has remained above the same ever since, hence none of the formations between the (15) Permian and (20) Quaternary are found in this State.

15. Permian or Permo-Carboniferous, Upper Barrens.* [XVI. Serail.]*

The Permian beds, according to Fontaine and White, include all the stratified rocks in West Virginia above the horizon of the Waynesburg coal. The series has a maximum thickness of 1,500 feet, and consists of red shales, sandstones and limestones, there being three or four thin coal beds in the lower half of the group, but none whatever in the upper. The beds are all apparently of fresh water origin, since the limestones contain no fossils except *Spirorbis*, *Cypris*, *Esteria*, and other bivalve crustaceans. The plant remains are principally Ferns of Permian type, including *Callipteris conferta*, though *Theniopteris*, *Baiera* and others recall Mesozoic forms. The formation enters the State from the southwest corner of Pennsylvania and stretches across it to the Great Kanawha River in a belt 30-50 miles wide.

1. By Professor I. C. White, United States Geologist, and lately on the Second Geological Survey of Pennsylvania.

2. *Permian*. The evidence of the existence of the Permian or Permo-Carboniferous formation in West Virginia is contained in Vol. P.P. of the Second Geological Survey of Pennsylvania, by Wm. M. Fontaine and I. C. White, 1880.

J. M.

* The names and numbers enclosed in square brackets are those given to the formations by Wm. B. Rogers, late State Geologist of Virginia.

14a. Upper Coal Measures, Monongahela Series. [XV. Seral.]

In the northern portions of the State contains four coal beds in descending order, as follows:

Waynesburg bed, merchantable coal.....	4-6 ft.
Interval limestones, shales and sandstones.....	250 ft.
Sewickley bed, merchantable.....	4-5 ft.
Interval limestones and shales.....	65 ft.
Redstone bed, worthless.....	3-4 ft.
Interval limestones, shales and sandstones.....	40 ft.
Pittsburg bed, merchantable coal.....	6 ft.

Total thickness..... 374 ft.

In Southern West Virginia, on Great Kanawha River, the group has undergone the following changes: The Sewickley and Redstone coals are absent; the Waynesburg is thin and worthless; the group has lost all its limestones except one thin stratum; it has also lost 100 feet of rock, intervals being reduced to 275 feet; red shales are abundant on the Kanawha River; there are none in these measures on the Monongahela; the Pittsburg coal maintains 5 ft.-6 ft. of merchantable coal, but it is often absent entirely from wide areas, or only 1 ft.-2 ft. thick on others.

14b. Barren Measures. [XIV. Seral.]

Northern West Virginia shows the following structure:

Shales, sandstones and limestones, sometimes including a thin coal.....	200 ft.
Morgantown sandstone.....	25 ft.
Elk Lick coal.....	0-4 ft.
Shales.....	75 ft.
Green crinoidal limestone, very fossiliferous.....	2 ft.
Coal.....	0-1 ft.
Red and variegated marley shales.....	100 ft.
Bakerstown coal.....	0-4 ft.
Shales and sandstones.....	40 ft.
Upper Mahoning sandstone, pebbly.....	50 ft.
Brush Creek coal.....	0-3 ft.
Lower Mahoning sandstone.....	75 ft.
Shales.....	12 ft.

Total 585 ft.

On the Great Kanawha this group thickens up to 800 feet; the green crinoidal limestone disappears, but is exactly replaced strati-graphically by one of fresh water origin. The Brush Creek coal attains important dimensions, and two new ones are introduced below it, while the series is terminated by the "Black Flint," a marine deposit of dark gray, or blackish flint peculiar to the Kanawha valley, and exhibiting every gradation between sandy shale and compact siliceous.

The coals of the barrens are everywhere variable and uncertain. A bed may be present in good thickness on one farm, while on the adjoining land it may be absent entirely, or so impure as to prove worthless. The Brush Creek seam is the persistent and important one.

14b. Lower Coal Measures. Allegheny River Series. [XIII. Seral.]

These measures are 250 feet thick at the northern line of the State, and usually contain five coal beds, in the following order:

Upper Freeport Coal—	
Interval.....	50 ft.
Lower Freeport Coal—	
Interval.....	75 ft.
Middle Kittanning Coal—	
Interval.....	35 ft.
Lower Kittanning Coal—	
Interval.....	60 ft.
Clarion Coal—	
Interval to top of XII.....	20 ft.

The Upper Kittanning Coal, which is often present in Pennsylvania, seems to be absent in Northern West Virginia, though it comes into the section on the Kanawha River. The Upper Freeport and Lower Kittanning are the only ones of these five that are valuable, since the others are usually too thin and slaty. The first is generally 4 ft.-6 ft. thick and the latter 3 ft.-5 ft. This series gradually expands southwestward, and on the Kanawha River attains a maximum thickness of 1,100 ft., in which its six productive coal beds are disposed somewhat as follows:

Upper Freeport ("Cannelton Lower") bed—	
Interval.....	100 ft.
Lower Freeport ("Coalburg") bed—	
Interval.....	75 ft.
Upper Kittanning ("Winnifrede") bed—	
Interval.....	350 ft.
Middle Kittanning ("Cedar Grove") bed—	
Interval.....	115 ft.
Lower Kittanning ("Campbell Creek") bed—	
Interval.....	120 ft.
Clarion (Eagle) bed—	
Interval to top of No. XII. in which two or three thin coal streaks occur.....	340 ft.

The six coal beds given above are never all workable in the same section; in fact it is rare that more than two of them furnish valuable coal on the same property. The Lower Kittanning is probably the most persistent of the Kanawha coals.

14a. Pottsville conglomerate. New River Coal Series. [XII. Seral.]

The No. XII series has the following structure in Northern West Virginia, on Cheat River:

Massive, pebbly, sandstone, sometimes in two or more beds with intervening shales, the whole representing the Homewood and Cannoqueens sandstones of Pennsylvania.....	150 ft.
Coal.....	1-2 ft.
Black Slate.....	10 ft.
Gray Sandstone to base of XII.....	25 ft.

Southward across the State this series thickens, even to a greater extent than XIII, and in the New River (southward continuation of the Kanawha) region, attains a maximum of 1,300 ft., in which are three important coal beds in the following order, descending from top of XII:

Massive sandstones and conglomerate with a thin coal, 175 ft. below top.....	400 ft.
Nuttall Coal.....	
Shales and massive sandstones.....	250 ft.
Coal.....	
Shales and sandstones.....	100 ft.
Coal.....	
Shales and massive sandstones to base of No. XII.....	550 ft.

Total.....1,300 ft.

These three beds are coking coals of the finest quality, and one of the two lower appears to be identical with the great ten-foot seam of the Flat Top country. These coals are found of workable thickness only around the southern margin of the coal area, in a belt of country 20-30 miles wide, north from which they thin away to insignificant streaks. The Nuttall bed would correspond to the Quakertown coal of Pennsylvania, and the other two would represent the *Sharon* and its "rider."

13. Sub-Carboniferous.**13a. Manach Chunk Shales. [XI. Umbral Shales.]**

On Cheat River consists of shales, green sandstones, and thin limestones, with iron ore next the top; total thickness 300 ft., in which are only 10 ft.-15 ft. of red shale. On New River this series is not less than 2,000 ft. thick, consisting of red shales, green and gray sandstones, with an impure limestone at the top of the group.

13b. Mountain or Greenbrier Limestone. [XI. Umbral Limestone.]

100 ft.-150 ft. thick in Monongalia Co., but increases to over 800 ft. in Greenbrier Co. Is absent entirely over a large portion of the Northern region of the State west from Chestnut Ridge.

13a. Poccono Sandstone. [X. Vespertine Sandstone.]

Hard gray current bedded sandstone and conglomerate, 500 ft.-600 ft. thick on Cheat River, and 1,000 ft.-1,200 ft. in the Allegheny Mountains along B. & O. R. R. No measurements have been made in southwestern portion of the State.

5-12. Devonian.**12. Catskill. [IX. Ponent.]**

Red shales, green and red sandstones, and an occasional conglomerate, 800 ft. thick at Rowlesburg, B. & O. R. R., and 1,200 ft.-1,500 ft. in Allegheny Mountains; thins away to almost nothing west from Chestnut Ridge.

11-12. Chemung-Catskill. [VIII. and IX. Ponent and Vergent in part.]

Green and gray flaggy sandstones, fossiliferous, also containing occasional red beds, and a conglomerate with flat pebbles, (1st Venango oil sand and gas rock at Washington and Murrysville), thickness near Keyser down to lowest red bed 800 to 1,000 ft. These rocks have sometimes been classed with the Catskill and again with the Chemung. In Penna. Geol. Report G⁷, p. 63, the desirability of the present classification is fully set forth.

11b. Chemung

and

11a. Portage.

[VIII. Vergent.]

A series of hard, flaggy sandstones and shales, with a massive conglomerate (3d Venango oil sand) 100 to 200 ft. below the top; no red beds whatever; sparingly fossiliferous; thickness about 2,500 ft.

10c. Genesee. [VIII. Cadent.]

Black slate and dark shales; thickness 150 to 200 ft. along B. & O. R. R.

10b. Hamilton. [VIII. Cadent.]

Dark brown sandstones and sandy shales, very fossiliferous; thickness along B. & O. R. R., 600 to 800 ft.

10a. Marcellus. [VIII. Cadent.]

Black and gray slates with beds of impure gray limestone at base. The entire group 500 to 600 ft. along the B. & O. R. R.

9. Corniferous. [VIII. Cadent.]

Wanting in West Virginia.

5-8. Upper Silurian.**8. Oriskany. [VII. Meridian.]**

A coarse, dirty yellow fossiliferous sandstone, 75 to 150 ft. thick.

7. Lower Helderberg. [VI. Pre Meridian.]

Highly fossiliferous gray and blue limestones, 400 to 500 ft. thick.

6. Salina. [V. Scalent.]

Greenish magnesian limestones, red and variegated shales, the whole having a thickness of 800 to 900 ft. along B. & O. R. R.

5c. Niagara (?) and } [V. Scalent and Surgent.]**5b. Clinton.**

Hard, flaggy sandstones; thin limestones and shales, in which occur two beds of iron ore, the thickness of all being 400 to 500 ft. along B. & O. R. R.

5a. Medina and Oneida. [IV. Levant.]

Hard, white sandstone (White Medina) at top 400 to 500 ft. thick, succeeded by red shales and sandstones 800 and 1,000 ft. (Red Medina), and followed by gray sandstones and conglomerate (Oneida), 200 to 500 feet thick.

Baltimore & Ohio Railroad.				Baltimore & Ohio Railroad—Con.			
Ma.	From Harper's Ferry West.*	Alt.		Ma.	From Harper's Ferry West.*	Alt.	
81	Harper's Ferry. ⁴	Huronian.	272	139	Rockwell's Run.	Devonian.	499
87	Duffield's.	Sil. Cam. L. S.	562	140	Doe Gully Tun'l. ⁸	Catskill.	545
92	Kearneysville.	"	589	155	Little Cacapon.	Devonian.	563
95	Vandlieveville.	"	500	161	S. Br. Pot. River.	"	580
100	Martinsburg. ⁵	"	488	168	Green Spr. Run. ⁹	Hamilton.	583
.....	{ Shepardstown	"	467	170	Patterson's Ck. ¹⁰	"	568
	{ Road.	"		.....	N. Br. Potomac.	"	604
107	North Mountain. ⁶	Sil. and Dev.	547	178	Cumberland. ¹¹	L. Helderberg.	639
118	Cherry Run.	Devonian.	598	185	Brady's Mill.	L. Helderberg.	643
117	Sleepy Creek.	"	410	191	Rawling's.	"	698
122	Hancock.	"	428	198	Black Oak Bottom.	"	736
128	Sir John's Run. ⁷	Medina.	434	198	Potomac Bridge.	Hamilton.	786
181	Great Cacapon.	Hamilton.	449	201	Keyser. ¹²	L. Helderberg.	800
188	Willett's Run.	Devonian.					

2-4. Lower Silurian or Cambrian.

4c. Hudson River Shales. [III. Matinal.]

Dark brown shales and slates usually cleaved, probably 2,000 to 3,000 ft. thick on B. & O. R. R., west from North Mountain; no exact measurements have been made.

4a. Shenandoah Valley Limestone. [II. and III. Matinal and Aural.]

Limestones of great thickness, and some of it very pure; no trustworthy measurements have been made, but it is probably not less than 4,000 to 5,000 ft. thick along B. & O. R. R.

2b. Potsdam Sandstone. [I. Primal.]

Found only in Blue Ridge at eastern line of State, where it consists of quartzites and slates, whose thickness has not been accurately determined, but it is probably not less than 2,000 to 3,000 ft.

1. Archsean.

1b. Huronian. Rocks of this age supposed to exist in the gap of the Potomac through the Blue Ridge at Harper's Ferry.

3. Professor White thinks the geology of West Virginia can be best studied by beginning at Harper's Ferry, in Maryland, at the bottom of the series of formations. By this means the road between that place and Cumberland is given twice. J. M.

4. The gorge at Harper's Ferry is cut through metamorphic rocks, of probably Huronian age. One and a half miles west of the station, a fault brings down the Potsdam and Calciferous rocks against the Azole. From this point, 83 miles, to near North Mountain, 107 miles, a wide belt of Lower Silurian limestone occurs, with occasional bands of slate, embracing the rocks from the 3 a. Calciferous to and including the 4 c. Hudson River. These have never been separated in this region. The limestone predominates by far, and will be spoken of as the 2-4. Siluro-Cambrian. (F.)

5. Martinsburg. Splendid quarries in No. II. limestone here. One mile east from Martinsburg a syncline catches the Hudson River slate and the limestone goes under for two or three miles, then reappears, and again goes under to come up once more near Kearneysville. These crumples near the centre of the valley are the northeastern extension of the great trough which holds Massanutten Mountain, 50 miles south from Martinsburg.

6. North Mountain. On the west side of this limestone belt a great fault brings down in North Mountain the various Silurian and Devonian formations, from the 5 a. Medina to the 13 a. Vesper-tine or No. X., which are to be seen in North Mountain and its immediate vicinity. (F.)

7. Sir John's Run. From this point westward to Cumberland the rocks are thrown into a series of great arches, whose corresponding troughs catch the *Pocono beds* in the tops of the mountains, and bring up the Lower Helderberg limestone on the anticlinals, so that frequently several formations may be seen near one station. (F.)

8. Doe Gully. Fine exposures of Catskill rocks in the approaches to the tunnel, which cutting through them parallel to the strike, permits the highly inclined beds to slide down into the cuts from a long distance up the sloping side.

9. Green Spring Run. The valley here is a syncline of Genesee, Hamilton and Marcellus rocks, enclosed on either side by anticlinal ridges of Oriskany sandstone, making Mill Creek Mountain on the east and Patterson's Creek Mountain on the west.

10. Patterson's Creek. Another synclinal valley of Hamilton beds, bordered east and west by anticlinal ridges of Oriskany. Under the arch of the eastern one the Lower Helderberg limestone is brought above water level and quarried on the Maryland side of Potomac.

11. Cumberland. Good geological headquarters. The great Will's Creek Mountain anticlinal just east from the city, brings up the Red Medina, spanned by a splendid arch of White Medina, through which the creek has carved a narrow cañon, in which there is barely room for the two R. R.'s and the National turnpike. The Clinton, L. Helderberg, Oriskany and Hamilton all exposed near city. The low mountain which begins on the Virginia side at Cumberland, and trends away to the southwest, is made by the massive Oriskany sandstone and called Knobby or "Knobley."

12. Keyser. Splendid ground for geologists. The Potomac river turns squarely around to the northeast on leaving Cumberland and the R. R. follows this direction almost parallel to the strike of the rocks, and hence along the crest and sides of the great Will's Creek Arch, which the river has worn down and converted into a valley from Cumberland to Keyser, with Knobley Mountain (Oriskany) on the south, and Dan's Mountain (Pocono and No. XII.) on the north, from the highest peak of which, opposite Brady's Mill, is one of the grandest views in all the Appalachian region. Queen's point, opposite Keyser, is an arch of Oriskany, under which comes fine exposures of L. Helderberg, both

Baltimore & Ohio Railroad.			Baltimore & Ohio Railroad— Continued.		
Ms.		Alt.	Ms.		Alt.
0	Baltimore, Md.		.....	E. P. Kingwood T.	50' under the U.
206	Piedmont.	14 a. Pottsville Cg. ²²⁵	.....	Freeport Coal. ¹⁸¹⁹	
.....	Potomac Bridge.	" 999	261	W. P. " 16	Freeport limestone at track level. 1779
208	Bloomington.	" 1024	.....	
214	Frankville.	13 b. M. Chunk. ¹⁶⁹⁹	264	E. P. Murray's T. ¹⁷	U. Freeport Coal at track level. 1554
220	Swanton Water St.	" 2282	267	Newburg. ¹⁸	Barrens. (XIV.) 1215
223	Altamont.	13 a. Pocono. 2620	.....	Hook's Run.	" 1164
226	Deer Park. ¹⁸	11 b. Chemung. 2442	268	Independence.	" 1156
229	Mt. Lake Park.	" 2400	.....	Helvetia.	" 1110
.....	Little Yough Br.	" 2398	.....	Raccoon Creek Br.	" 1105
232	Oakland.	13 b. M. Chunk. ²³⁷²	.....	Thornton.	" 1088
.....	Little Yough Br.	14 a. P'tville Cg. ²³⁷¹	274	Water Sta. No. 59.	" 1082
233	Great Yough Br.	" 2372	.....	Three Fk. C. Br. ¹⁹	" 1020
.....	Chisholm Summit.	" 2487	280	Grafton.	" 987
238	Hutton's.	" 2477	281	Fetterman.	" 984
240	Snowy Creek Br.	12 Catskill. 2469	.....	Plum Run Bridge.	" 978
242	Terra Alta.	11 b. Chemung. 2549	287	Valley River F. ²⁰	Nos. XII., XIII. 969
243	E. P. McGuire's T.	" 2882	.....	Nuzum's Mills.	No. XIII. 986
246	Rodemer's Tunnel.	12 Catskill. 2088	294	Texas.	Barrens. (XIV.) 888
250	Salt Lake Bridge.	" 1619	297	Benton's Ferry.	" 888
253	Cheat River Br.	11 b. Chemung. 1892	.....	Mon. River Br.	" 877
253	Rowlesburg. ¹⁴	12. Catskill. " 1892	302	Fairmont. ²¹	" 877
254	Buckeye Run Vt.	Base Catskill. 1516	303	Barnesville.	14 c. Up. Coal M. 871
255	Tracy Run Vt.	Fine ex. of Cat. ¹⁵⁷²	.....	Buffalo Creek Br.	" 891
257	Buckhorn R. Vt. ¹⁵	13 b. M. Chunk. ¹⁷²⁰	307	Barracksville.	" 901
259	Cassidy's Summit.	Tp. 14 b. L. Cl. M. ¹⁸⁵⁵	.....	Davis Run.	" 916
260	Tunnelton.	14 b. L. Col. M. 1820	.....	Dunkard Mill.	" 922

very fossiliferous. The R. R. cut at Bull Neck, just below Keyser, is through a sharp syncline of Oriskany. The L. H. limestone, Salina, Clinton and White Medina, all finely exposed along Limestone run near town; while the Hamilton, Chemung, Catskill, Pocono, Mauch Chunk and Pottsville conglomerate come down in succession along the R. R. between Keyser and Piedmont.

13. *Deer Park.* West of Altamont the railroad continues on a broad, undulating plateau, the Savage and Allegheny Mountains of Pennsylvania having here coalesced into one. This remarkable flat mountain top, from 2,400 to 2,600 feet in height above tide, has always attracted much attention from the comparative softness of the outlines, giving the park-like character to its topography. (F.)

14. *Rowlesburg.* Here the R. R. starts up another steep grade to the crest of Laurel ridge, and the view to the right (in going west) down the course of Cheat, is the grandest of all the B. & O. R. R. scenery. The geological picture is no less interesting, since the road bed is almost a continuous rock-cut for 5 miles, thus giving a nearly clean exposure of the column of rocks from the top of the Chemung up through 700 ft. of Catskill, 566 ft. of Pocono, 712 ft. of Mauch Chunk, 308 ft. of Pottsville Conglomerate, 310 ft. of Lower Coal Measures, and 200 ft. of the Barrens (No. XIV.).

15. *Buck Horn Run.* All of these viaducts cross wild gorges 75 ft.—100 ft. deep, and at the Gray Run gorge the cars are apparently directly over Cheat River, 200 ft. below.

16. *W. Portal Kingwood Tunnel.* Kingwood Tunnel is 4,132 ft. long and passes through Laurel Hill, the anticlinal axis of which crosses the R. R. somewhere near the eastern end of the tunnel, since the U. Freeport coal has there an elevation of 1,865 ft. A. T. and dips eastward, while at the western portal the same coal is 1,805 ft. A. T. and dipping rapidly westward. The summit of the mountain is made by 200 ft. of Mahoning sandstone.

17. *East Portal Murray's Tunnel.* U. Freeport coal here 3½ ft.—4½ ft. thick, and extensively coked at Austin mines 20 ft. under R. R. track, just west from Murray's Tunnel.

18. *Newburg.* A small area (300–400 acres) of the Pittsburg coal is caught in the summit of the hills here near the centre of the trough between Laurel Hill and Chestnut Ridge anticlinals. The Pittsburg coal has an elevation of 500 ft. above R. R. and is transported to the latter over a long incline. A shaft has recently been sunk near the foot of the incline which passed through the U. Freeport coal, 4 ft. thick at 169 ft., and the Lower Kittanning bed, 7 ft. thick at 359 ft.

19. *Three Fork Creek Bridge.* Three miles up Three Fork Creek is Irondale Furnace where native ore (from 150 ft. above U. Freeport coal) is principally used, and the U. Freeport coal furnishes the coke. A branch R. R. connects it with B. & O. at mouth of Three Fork.

20. *Valley River Falls.* The anticlinal axis of Chestnut Ridge crosses the river here and brings up the conglomerate rocks of No. XII. to 150 ft. above water level, over which the stream descends in a series of wild cascades. The hills are capped by the Mahoning sandstone, thus exposing all of No. XIII.

21. *Fairmont.* The Pittsburg coal comes about 75 ft. above the track here and is extensively mined and shipped east for gas and steam purposes.

Baltimore & Ohio Railroad— Continued.			Parkersburg Branch B. & O. Railroad.		
Ms.		Alt.	Ms.		Alt.
312	Farmington. ²²	927	0	Grafton.	Barrens (XIV.) 987
.....	Wood's Run.	957	4	Webster.	" 1019
319	Mannington. ²³	967	7	Bartlett C'k Sum.	" 1147
326	Glover's Gap.	1150	10	Flemington. ²⁹	" 1030
.....	Glover's Gap Tun.	1146	17	Bridgeport.	" 975
330	Burton. ²⁴	1060	20	Carr's Tun., W. E.	" 1102
.....	E. Por. U. Eaton T.	993	22	Clarksburg. ³⁰	" 1020
.....	E. Por. L. Eaton T.	962	26	Wilsonburg. ³¹	" 979
337	Littleton.	936	30	Wolf's Summit.	14 c. Up. Coal M. ¹¹⁸⁶
340	E. P. B. Tree Tun.	1104	36	Salem.	Permian (XVI.) ¹⁰⁴³
.....	W. P. B. Tree. ²⁵	1077	46	Smithton.	14 c. Up. Coal M. ⁷⁹⁰
344	Bellton. ²⁶	886	48	West Union. ³²	" 832
.....	E. Por. Welling T.	1202	52	Central.	Permian (XVI.) 809
.....	W. Por.	1193	59	Tollgate.	" 787
351	Cameron.	1049	62	Pennsboro.	" 832
356	Easton.	967	67	Ellenboro. ³³	" 777
.....	E. P. Shepard's T.	888	72	Cornwallis.	" 676
361	Op. Rosby's Rock.	787	75	Cairo.	" 667
362	Rosby's Rock.	773	82	Petroleum. ³⁴	" 684
368	Moundsville. ²⁷	640	94	Kanawha.	" 599
373	McMechens Cut.	664	94	Claysville.	" 599
375	Benwood.	648	104	Parkersburg. ³⁵	" 636
379	Wheeling. ²⁸	645			

22. *Farmington.* The Waynesburg bed is mined here about 150 ft. above track, the Pittsburg being more than 200 ft. under water level.

23. *Mannington.* The Waynesburg coal, or highest number of the Carboniferous proper, goes under the R. R. track $2\frac{1}{2}$ miles east from Mannington, and from there to near the Ohio river the rocks belong to the Permian or Permo-Carboniferous series, the No. XVI. of Rogers. The Washington coal is 75 ft.—100 ft. above track at Mannington.

24. *Burton.* In the region between here and Bellton are to be found the highest rocks of the Permian series, some of the summits attaining an elevation of 1,200 ft.—1,500 ft. above the Waynesburg coal.

25. *West Portal Board Tree Tunnel.* Ninevah coal, the uppermost small bed of the Permian series, 50 ft. over track here.

26. *Bellton.* A fine locality for Permian exposures in the steep hills, which rise 600 ft. to 700 ft. above water level. A hole bored for oil a short distance above Bellton, passed through the Waynesburg coal at 400 ft. below creek level.

27. *Moundsville.* The Pittsburg coal underlies the Ohio river about 90 ft. at Moundsville, and is mined by shafts. The Waynesburg bed is 170 ft. above the river, but impure, and only $2\frac{1}{2}$ ft.—3 ft. thick.

28. *Wheeling.* The Pittsburg coal is about 100 ft. above river here, and fine exposures of the entire Upper Coal Measures (260 ft. thick), and the lower portion of Permian may be seen in the steep hills around Wheeling.

29. *Flemington.* Here the Lower Coals and Lower Barren Measures are shown, with a small remnant of the Pittsburg bed in the tops of the hills, it being the seam worked there. (F.)

At this station is the eastern outcrop of the Pittsburg coal bed, west from the anticlinal of Laurel Hill (Chestnut Ridge of Pennsylvania). From this locality the coal and the railroad level constantly approach, until at Wolf's Summit, a little west from Wilsonburg, the coal is under the track. (S. & F.)

30. *Clarksburg.* Pittsburg coal extensively mined here and westward to Wilsonburg. It is also coked and shipped to Chicago and elsewhere for purposes other than the manufacture of iron.

31. *Wilsonburg.* Just before reaching Wolf's Summit, the Pittsburg coal bed is at the railroad level, and is worked near the track at the Summit. The Redstone coal bed is seen two inches thick in the Summit cut. Between the Summit and the Brandy Gap Tunnel the Waynesburg coal bed is seen and is worked just south from the railroad, the opening being visible from the track. At the west end of the tunnel the Washington coal bed is exposed above the track. This is in the Upper Barren Measures. (S.)

32. *West Union.* The Waynesburg coal is mined to a small extent here and eastward beyond Smithton, but is thin (2 ft.—4 ft.) and impure. The roof shales contain numerous finely preserved fossil plants at West Union.

33. *Ellenboro.* Prof. Stevenson is now inclined to believe that what he has described in this region as faults are only very sharp anticlinal axes, and that what is known as the "Oil Break" is simply a great anticlinal arch, and in this view Prof. White coincides, though he has made no special investigation of the question. The oil obtained at Volcano and other localities in this region comes from the Pottsville conglomerate, according to Stevenson.

34. *Petroleum.* About one-fifth of a mile east of this station, a fault crosses the railroad, which brings up the Lower Barren Series against the Upper Barren Series. Thence, from Ellenboro to within a short distance of Petroleum station, the rocks are nearly horizontal, and the Upper Freeport coal bed is exposed in several of the cuts. But, near Petroleum, there is a most remarkable upheaval,

Wheeling & Pittsburg Branch B. & O. R. R.			Chesapeake & Ohio Railroad—		
Ms.		Alt.	Ms.	Continued.	Alt.
0 Wheeling. ²⁸	Barrens (XIV.)	645	307 Caldwell.	11 b. Chemung.	1765
2 Mt. DeChantel.	14 c. U. Coal M.	673	312 Ronceverte. ⁴²	13 b. Mauch Chunk	
4 Carbon. ³⁶	"	667		(XI.)	1660
9 Roney's Point. ³⁷	"	829	319 Fort Spring.	"	1625
10 Point Mills.	Permian (XVI.)	896	326 Alderson.	"	1550
16 West Alexander.	"	1043	328 Mohler.	"	1540
21 Claysville. ³⁸	"	1143	334 Greenbrier St'k Yds	"	1530
28 Chartier.	"		336 Lowell.	"	1510
32 Washington. ³⁹	"	1049	337 Talcott.	"	1510
Chesapeake & Ohio Railroad. *			343 Don. ⁴³	"	1423
297 Alleghany Tun. ⁴⁰	Pocono (X.), Cat. (IX.)		348 Hinton. ⁴⁴	"	1377
298 Tuckahoe.	11 b. Chemung.	3086	350 Barksdale.	"	1345
802 White Sulphur. ⁴¹	10 b. Hamilton.	1920	356 New Richmond. ⁴⁵	"	1290
305 Hart Run.	"	1814	360 Meadow Creek.	"	1265
			364 Slade.	"	1237
			369 Quinnimont. ⁴⁶	"	1196

* *Chesapeake & Ohio Railroad.* Prof. Wm. B. Rogers' account of the geology of this road in Virginia and in West Virginia, as given in the first edition, is re-produced in the chapter on Virginia; but since its publication the country has been greatly developed and studied, and Prof. White has therefore prepared a more extended and minute description of the portion of that road in West Virginia.

which has brought up the lower coals, the strata suddenly rising within a few yards to an angle of 80 degrees. Just west of Laurel Fork Junction the rocks dip down again, the conditions being here on the west side similar to those at Petroleum on the east. After passing the first cut west from the station, the dip is suddenly reduced from 50 degrees to nearly horizontal. This forms the so-called "Oil Break," as all the productive oil wells are found along the line of this belt. This belt is about one and a half miles wide, running in a direction a little east of north and gradually flattening out toward each extremity, and forms one of the most remarkable geological features in this State. This curious disturbance is well worth a visit. Near it, a few miles off by a branch road from Cairo, is the vertical chasm, 4 feet wide, which was filled with the mineral Grahamite, now worked out. There is a fault at Kanawha, forming the western boundary of the disturbed region, as that at Ellenboro is the eastern. (S. & F.)

35. *Parkersburg.* The Washington coal, about 100 ft. above the base of the Permian series, is found at low water of the Ohio here, while the horizon of the Pittsburg bed would be about 360 ft. under the river, but it is altogether probable that the Pittsburg has here thinned away, since borings give no trace of it, and at Burning Springs where the "Oil Break" anticlinal brings up its horizon, the coal is absent.

36. *Carbon.* Pittsburg coal mined here by shaft 65 ft. deep.

37. *Roney's Point.* Waynesburg coal mined locally, only $2\frac{1}{2}$ ft.—3 ft. thick, and impure.

38. *Claysville.* Washington coal at track level, $1\frac{1}{2}$ miles west from borough. Claysville anticlinal of Stevenson crosses R. R. one-quarter mile west from station.

39. *Washington.* The Harvey, Hoff and Hess gas wells supply the town with fuel; these three gas wells all on a line along the crest of the Washington anticlinal, were so located on scientific grounds by Prof. I. C. White. The Gantz Well, one mile southeast from the anticlinal obtained oil from the same sand (1st Venango) that the others get gas from. The Gantz Well struck the sand at 2,200 ft., passing through Pittsburg coal at 350 ft., while the Hess well got gas at 2,068 ft., passing the same coal at 250 ft.

40. *Alleghany Tunnel.* The line between Virginia and West Virginia is crossed near center of tunnel through the Alleghany Mountain, the backbone of which is the Pocono sandstone.

41. *White Sulphur.* A well known summer resort, famed for the curative properties of its mineral water, which issues from the Oriskany sandstone in a large spring, flowing 75 to 100 gallons per minute.

42. *Ronceverte.* The railroad passes through the Pocono sandstone (X.) at Louisa tunnel, between Ronceverte and Caldwell, and then enters a long stretch of No. XI. limestone and shales along the Greenbrier River. The limestone is over 800 ft. thick, and forms the rich belt of blue grass country, which extends through Monroe, Greenbrier and Pocahontas counties. In the Pocono rocks at Louisa tunnel many fossil plants may be found.

43. *Don.* Near Don is the Big Bend tunnel, 6,080 ft. long, through No. XI. red shale, which cuts off several miles of meanders in the Greenbrier river.

44. *Hinton.* Junction of Greenbrier with New River. Here the railroad enters the cañon of the latter stream, a great gorge cut down 1,000 to 1,500 ft. below the tops of the bounding mountains, and in which the railroad runs for nearly 60 miles through some of the wildest scenery on the continent.

45. *New Richmond.* A splendid sandstone for building purposes crops out in the No. XI. sandy beds above the railroad here, and the West Virginia block for the Washington monument was quarried from the same. In the vicinity of Ronceverte and Alderson these sandy beds of XI. seem to be almost unrepresented, for the limestone there extends nearly up to the base of No. XII.; but as we enter the New River region a great mass of red shales, green and gray sandstones, etc., 1,500 to 2,000 ft. thick, wedges in between the main Greenbrier limestone below and 30 to 40 ft. of impure fossiliferous limestone at top, which immediately underlies the Pottsville (XII.) conglomerate. This upper limestone along New River holds the same fossils as an impure limestone in Monongalia County, which is separated from the main sub-carboniferous limestone by 50 ft. of sandstones and red shales.

Chesapeake & Ohio Railroad— <i>Continued.</i>			Chesapeake & Ohio Railroad— <i>Continued.</i>		
Ms.		Alt.	Ms.		Alt.
870	Prince.	18 b. Mauch Chunk (XI). 1192	416	Frederick.	14 b. L. Coal Meas., Clar. (Eagle) and L. Kit. coals. 641
872	McKendree. ⁴⁷	" 1180	417	Crescent.	" 638
879	Stone Cliff. ⁴⁸	Base of (XII). 1076	418	Cannelton. ⁵⁴	14 b. L. Coal Meas. (Eagle bed.) 636
881	River View.	" 1072	421	Dego.	14 b. L. Coal M., 75' under L. Kit. 632
882	Dimmock.	" 1045	423	Paint Creek. ⁵⁵	100' under L. Kit. 622
886	Fire Creek. ⁴⁹	Top of No. (XI). 1029	425	Blacksburg. ⁵⁶	5' above L. Kit. Cedar Grove (U. Kittan.) mined here. 626
887	E. Sewell.	Base of (XII). 1008	427	Coalburg. ⁵⁷	14 b. L. Coal M. 625
888	Sewell. ⁵⁰	" 1004	431	Winnifred June. ⁵⁸	14 b. L. Coal M. 616
890	Caperton.	" 984	435	Brownstown.	14 b. L. Coal Meas., axis crosses here 608
892	Nuttall. ⁵¹	" 948	438	Malden. ⁵⁹	14 b. L. Coal M., 20' under L. Kit. coal 605
894	Fayette.	L. half of (XII). 908	444	Charleston. ⁶⁰	Base XIV. (Bar.) 602
896	Elmo.	" 860	449	Spring Hill. ⁶¹	Mahoning sands. 600
899	Hawk's Nest. ⁵²	Middle of (XII). 828	455	St. Albans.	Middle of Barrens 594
401	Cotton Hill.	Up. half of (XII). 796	459	Scary. ⁶²	" 590
406	Gauley.	Base of Homewood sandstone. 708			
408	Kanawha Falls. ⁵³	Top of (XII). 672			
413	Loup Creek.	Homewood s. s. 647			
418	Mt. Carbon.	14 b. L. Coal Meas., Clar. and Lower coals mined. 629			

and the two are very probably identical, though the intervening rocks have increased 30 fold in thickness on New River.

46. *Quinnimont.* The No. XII., or New River coal series, comes into the tops of the adjoining mountains here, and one of its coal beds, which comes 600 ft. above the base of XII., has been mined and coked for use in the iron furnace situated at Quinnimont. It makes a splendid coke, as does each of the three workable beds in No. XII. The elevation of the Quinnimont bed is 1,050 ft. above railroad.

47. *McKendree.* About half way between this station and Prince, the upper or Chester limestone mentioned in Note 45 comes down to track level, and presents a fine opportunity for collecting sub-carbo-iferous (Chester) fossils.

48. *Stone Cliff.* Mines in Fire Creek and Nuttall coals, the former at 650 ft. above river, the latter at 950 ft.

49. *Fire Creek.* The Fire Creek coal here mined at 700 ft. above railroad, steepest incline on river.

50. *Sewell.* All of the three New River coals may be seen here. The Nuttall bed in the tops of the mountains, and the Quinnimont and Fire Creek below. These coals are of excellent coking varieties and very pure.

51. *Nuttall.* Nuttall coal, 400 ft. under top of XII. and 600 ft. above railroad, mined here. Uppermost great cliff rock of XII. seen capping the mountain here, from which the scenery is very grand.

52. *Hawk's Nest.* The Hawk's Nest cliff is on right bank of river, one mile below station, and here the upper members of XII. rise almost vertically from the bed of the river to 500 ft. above the same. The view from it is well worth a visit. The Anstead coal mines are in Gauley Mountain, four miles distant, and 855 ft. above C. & O. R. R. A narrow-gauge railroad leads out to them. The Lower Kittanning coal is the one mined. Nuttall coal is only 75 ft. above track at Hawk's Nest, and 2 ft. 8 in. thick.

53. *Kanawha Falls.* The falls are a series of cascades aggregating about 20 ft. in height over the hard current-bedded upper portion of the Homewood sandstone.

54. *Cannelton.* A good locality to study the lower coal measure series. The Clarion (Eagle) is just below track level. The Lower Kittanning bed is 105 ft. above, and extensively mined for gas coal, while on the north side here the U. Freeport coal may be seen at 750 ft. above river changed to a splendid cannel. From Mt. Carbon to near Charleston the track runs in No. XIII. beds, and coal openings are numerous on both sides of river. A general section of these measures is given in another connection.

55. *Paint Creek.* Paint Creek axis crosses here, and a railroad extends up Paint Creek for 10 miles to coal mines.

56. *Blacksburg.* Splendid example of erosion during coal measure times in cuts just above Blacksburg.

57. *Coalburg.* Splendid geological headquarters for seeing Coalburg, Cedar Grove and Brush Creek coals, and collecting fossil plants in roof of Lower Kittanning and Cedar Grove beds in Watson's Hollow, North Coalburg.

58. *Winnifrede Junction.* A railroad leads up Field's Creek seven miles to Winnifrede coal mines, the typical locality of Winnifrede bed (Upper Kittanning). On the other side of the river directly opposite, and in plain sight from the cars, is the mine of the Macfarlane Coal Company, in the Winnifrede bed, one of the best mines along the Kanawha, furnishing a very pure coal of splint and bituminous mixed, and in quality unsurpassed for domestic and steam purposes.

59. *Malden.* Cross to opposite side and examine extensive mines on Campbell's Creek (Lower Kittanning) coal, also salt works, the water being derived from base of XII.

60. *Charleston.* Good headquarters for studying barrens (XIV.). Three miniature faults in

Chesapeake & Ohio Railroad— <i>Continued.</i>			Ohio River Railroad— <i>Continued.</i>		
Ms.		Alt.	Ms.		Alt.
463	Scott. ⁶³	Barrens XIV., (upper half.) 683	38	New Martinsville. Permian (XVI.)	526
469	Hurricane.	Barrens (XIV.) 683	41	Sardis.	622
476	Milton.	" 586	43	Paden's Valley.	622
479	Thorndyke.	" 640	47	Sisterville.	642
480	Ona. ⁶⁴	" 622	51	Friendly.	617
482	B. Sulphur Spgs.	" 598	54	Long Reach.	{ Permian (XVI.) and 14 c. U. Cl. M. (XV.) Waynes Coal 20' above river. 617
485	Barboursville.	" 580	59	Raven's Rock.	{ Waynes Coal 20' above river. 616
491	Guyandotte.	" 560	61	Grape Island.	14 c. U. Cl. M. (XV.) 615
493	Huntingdon. ⁶⁵	" 566	63	St. Mary's.	" 615
501	Ceredo.	" 501	65	Vaughan.	{ Barrens (XIV.) " Oil Break " crosses river here. 617
502	Big Sandy, Ky.	" 502	68	Eureka.	Barrens (XIV.) 620
Ohio River Railroad.			71	Willow Island.	" 607
0	Wheeling. ²⁸	Barrens. (XIV.)	74	Bull Creek.	" 610
4	Benwood.	Pitts. Cl. nr. track. 639	81	Williamstown.	14 c. U. Cl. M. (XV.) 602
11	Moundsville. ²⁷	{ 14 c. Upper Coal Meas. (XV.) 635	83	Henderson.	"
19	Powhatan.	{ 14 c. Up. Coal Meas. 800' of XVI. in hills. 638	87	Briscoe.	Permian (XVI.)
23	Woodland.	14 c. U. Cl. M. (XV.) 633	88	Vienna.	"
26	Clarrington.	{ Waynes Coal 75' above river. 631	94	Parkersburg. ³⁵	" 596
31	Proctor.	{ 70' under Waynes Cl. at river level. 629	Ohio Central Railroad— Kanawha Division.		
36	Baresville.	{ Permian (XVI.) Waynes Coal nr. water level. 626	0	Charleston. ⁶⁰	{ 14 b. Base of (XIV.) Barrens. 600
			4	Lock No. 6.	14 b. Barrens. 592
			7	Smith's.	" 588

cuts of railroad, one mile above station, where U. Freeport coal and overlying "Black Flint" may also be examined. Great deposit of rounded pebbles and stones at junction of Elk and Kanawha here, finely exposed along cemetery road and extending to 385 ft. above river, the upper limit of the glacial dam-lake in which the deposit was made. From Charleston to Huntingdon the railroad runs in No. XIV., or the Barren Coal Measures.

61. *Springhill.* Great terrace of rounded boulders extend up over 200 ft. above river, just below mouth of Davis Creek, up which a railroad extends 15 miles to coal and Black Band iron ore mines.

62. *Scary.* Here the railroad leaves the Kanawha River following up Scary Creek, which leads out into an old valley (Teazes), at Scott, four miles distant. This singular valley, one mile wide and 200 ft. above the Kanawha River, bounded on either side by hills 200 feet higher, and extending through to the Guyandot River, which finally debouches into the Ohio, was once occupied by an arm of the Kanawha River, when the great ice dam at Cincinnati during glacial times backed the waters of the Ohio and its tributaries to a height of 500 to 600 ft. above present low water at Cincinnati. This hypothetical dam of Prof. G. F. Wright is demonstrated beyond any doubt by the great beds of clay, gravel, boulders and other trash which cover Teazes Valley to a great depth all along its course, except where subsequent erosion has removed them. When the ice dam melted away at Cincinnati, the water that had previously filled this valley was withdrawn, passing down to the Ohio by its former and present route, the Kanawha, thus leaving the ancient valley high and dry, though littered up with "Black Flint," pieces of canal coal, quartzite, sandstone and other rocks that testify to their Kanawha and New River origin.

The traveler should also notice the remarkably level character of the Kanawha Valley flats, on which the railroads are built, as shown by the altitudes given from Point Pleasant to Charleston, on the Ohio Central Railroad, and above Charleston, on the Chesapeake & Ohio Railroad. Another important fact is that the deposit which fills this valley is true loess, a lacustrine deposit similar to that on the Mississippi and Missouri River and elsewhere. J. M.

63. *Scott.* An excellent locality to study the ice dam lake deposits in a deep cut through them just east from station. The rounded boulders extend up to 750 ft. above tide here.

64. *Ona.* Lake deposits abundant.

65. *Huntingdon.* Mahoning sandstone makes cliffs along the hills from here to the State line at Big Sandy River.

66. *Saties.* An interesting group of mounds, the work of the Mound-builders, occurs in the wide bottoms toward the river, half way between this station and Charleston.

67. *Poca.* The Pittsburg coal is extensively mined in this vicinity by the Marmet Mining Co. The coal is absent in the immediate river hills, but comes in about one mile back. The horizon of this coal emerges from the bed of the Kanawha, between Buffalo and Red House, being mined at

Ohio Central Railroad— Kanawha Division.			Grafton & Greenbrier Railroad. ⁷³		
Ms.		Alt.	Ms.		Alt.
10 Ryans.	14 b. Barrens.	588	0 Grafton.	Barrens (No. XIV.) ⁹⁸⁸	988
12 Sattes. ⁶⁶	"	586	3 Fresh Ford.	"	988
15 Bowling.	"	584	6 Foreman's.	"	991
18 Poca. ⁶⁷	"	579	8 Sandy Creek.	L. Coal Meas.	1021
19 Raymond City.	"	586	11 Cove Run.	"	1072
20 Queen City.	"	579	14 Moatsville.	Cong. No. XII.	1155
21 Energetic.	"	576	17 Arden.	L. Coal Meas.	1260
26 Red House. ⁶⁸	14 c. Up. Coal Me.	577	19 Bryan's Mill.	"	1266
31 Martin's.	"	572	21 Newman's Trest.	"	1289
35 Buffalo.	"	570	22 Kelley's.	"	1287
38 18-Mile Creek.	"	564	24 Philippi.	"	1286
40 Grimm's. ⁶⁹	"	563			
42 Maupin's.	"	570			
45 Leon or 13 m. Ck.	"	567			
48 Beech Hill.	"	562			
50 Bright's.	"	564			
51 Rock Castle.	"	563			
56 River Switch.	14 b. Barrens.	557			
57 Ohio Riv. Bdge at Pt. Pleasant. ⁷⁰	"	597			
Pittsburg, Cincinnati & St. Louis R. R. Pittsburg, Wheeling & Kentucky Div.			Clarksburg & Weston R. R.		
0 Steubenville.	Barrens (No. XIV.) ⁷²⁸		0 Clarksburg.	16' under Pitts. Coal.	1030
1 Wheeling Junc.	"		(B. & O. Depot.)	"	1030
3 Middle Ferry.	"		2 West End.	130' "	945
4 Lower Ferry.	"		6 Mouth of Brown's Creek. ⁷³	100' "	945
6 Cross Creek.	"		8 Mt. Clare.	Barrens (XIV.)	1001
9 Wellsburg. ⁷¹	"		11 Bond's Summit.	"	1175
12 Beech Bottom.	"		13 Lost Creek.	"	1013
16 Short Creek.	"		14 Curry's Summit.	"	1196
21 Glenss.	"		18 Jane Lew. ⁷⁴	"	1004
25 Wheeling.	"	645	21 Fisher's Summit.	"	1232
			25 Weston. ⁷⁵	"	1008
Weston & Buckhannon R. R.					
			0 Weston. ⁷⁶	Barrens (No. XIV.) ¹⁰⁰⁹	
			5 Gaston.	"	1040
			6 Seymour.	"	1033
			11 Stone Coal Sum. ⁷⁷	Up. Cl. Me. (XV.)	1444
			11 Lorenz.	"	1435
			15 Buckhannon. ⁷⁸	Barrens (XIV.)	1403

Oak Ridge, four miles below Red House, where it is 20 ft. above river level. Its height is 175 ft. at Poca, and on up the river is carried into the air along the valley.

68. *Red House.* The great cliff near the hill top is the Waynesburg sandstone.

69. *Grimm's.* Here the Waynesburg coal has been opened 190 ft. above river level, where it is slaty, worthless, and only 3 ft. thick. A well, bored in search of the Pittsburg coal, found only a trace of that bed at 80 ft. under river.

70. *Point Pleasant.* The Pittsburg coal is here about 75 ft. above the Ohio River, but only 1½ ft. -2 ft. thick. The Waynesburg sandstone at the base of the Permian, or No. XVI. of Rodgers, makes cliffs near the summit of the hills.

71. *Wellsburg.* In this town, and the immediate vicinity, many strong gas wells have been struck at a depth of 1,300 ft. below the Ohio river. The gas is utilized for both heat and light in the town, and also supplies the glass and other manufactories. The geological position of the gas sand is about 1,650 ft. under the Pittsburg coal, and is possibly identical with the Murraysville sand. A shaft has also been sunk to the same coal that is mined at Steubenville, which Prof. Orton identifies with the Lower Freeport, and which is here about 210 ft. under the railroad.

72. The Grafton & Greenbrier is a narrow-gauge railroad, which follows the Tygart's Valley River southward from Grafton to Philippi, its track running for about six miles in the Barrens, No. XIV., then passing down through the Lower Coal Measures and into No. XII. three or four miles in the vicinity of Moatsville, and emerging at the horizon of the Upper Freeport coal at Philippi.

73. Pittsburg coal is mined and shipped from this point.

74. Pittsburg coal in tops of the hills about 300 ft. above track.

75. The Mahoning sandstone crops out along west fork of Monongahela River here, according to Prof. Stevenson. The State Insane Asylum, built of Barren Measures sandstone, is located at Weston.

76. This is a continuation of the Clarksburg & Weston Narrow Gauge Railroad.

77. The Pittsburg coal is 40 to 60 ft. under the track here.

78. The Pittsburg coal is mined in the hills around Buckhannon, probably 100 ft. to 150 ft. above the depot. It is 4 ft. to 4½ ft. thick.

79. By Mr. James Parsons, C. and M. E., Piedmont, W. Va.

80. From *Piedmont* to within one mile of Gorman the road runs at the base of the Piedmont sandstone, the north branch of the Potomac having cut its circuitous course through that stone and bedded itself upon the upper series of the conglomerate. The cliffs and bluffs formed by that stone tower high above the road on both sides, and the scenery becomes grand, beautiful and interesting.

The altitudes for West Virginia have been all carefully collected, from original sources, by Prof. L. C. White; many of them are here published for the first time.

Fairmount, Morgantown & Pittsburg R.R.*			West Virginia and Pittsburgh Railroad.		
Ms.		Alt.	Ms.	Braxton Extension.	Alt.
0	Fairmount. ⁸⁸	Up. p't'n of (XIV.) ⁸⁸⁸	6	Weston.	Pittsburgh Coal. 1018
1	Junction Bridge.	B'rns or No. (XIV.) ⁸⁹⁴	12	Roanoke.	14 c. in hills. 1088
	Low water, Monong. Riv. }	850	14	Arnolds.	14 c. Up. Coal M. 1098
8	Houlstown.	Base of (XV.) or Up. Coal Meas. 889	25	Burnsville.	{ Barrens, (XIV.) 788
4	Rievesville. ⁸⁹	No. (XV.) 888		L. Kanawha Riv.	{ 250' under P. Cl. 741
	Monong. R. here.	848	32	Salt Lick B'dges.	Barrens, (XIV.) 788
7	Prickett's C'k B'g.	Top of (XIV.) 888	85	Hecter's.	Barrens. 888
	River here.	848	38	Flat Woods.	" (XIV.) 1081
7	Catawba.	Top of (XIV.) 880	39	Summit.	" 1101
11	Opekiska. ⁸⁷⁴	Up. portion (XIV.) 889	44	Sutton.	828 Barrens, Mah. s. s.
	River here.	889	Buckhannon River Extension.		
17	Little Falls. ⁹⁰	Top of (XIII.) 888	0	Buckhannon.	Barrens, (XIV.) 1400
	M'th Tom's Run.	882	7	Sago.	" 1425
20	J. Kigers.	U. Freeport Coal. 887	18	Ten Mile. ⁹⁴	14 b. L. Cl. M. 1600
22	Offington. ⁹¹	Base (XIV.) 888	17	Alton.	" 1618
	River here.	791	25	Newlon.	" 1617
26	Morgantown. ⁹²	See note. 816	Ohio River Railroad.—Continued.		
Monongahela River Railroad.			94	Parkersburg.	Perm. C'b., (XVI.) 888
0	Fairmount. ⁸⁷⁹	75' under P'gh Coal. 889	107	Harris' Ferry.	" 896
6	Camdensburg. ⁹⁸	Pittsburgh Coal. 889	111	Belleville.	" 891
11	Worthington.	P'gh Coal in riv. 898	117	Murraysville. ⁹⁵	Waynesburg s. s. 898
18	Enterprise.	Pittsburgh Coal. 901	120	Muse's Bottom.	Perm. C'b., (XVI.) 888
16	Shimston.	" 911	123	Portland.	" 892
23	Simpsons Creek.	" 928	125	Sherman.	" 887
27	Bartlett.	" 931	128	Ravenswood. ⁸⁸⁸	Waynesburg "A" Cl. 881
82	Clarksburg.	" 1081	132	Pleasant View.	Perm. C'b., (XVI.) 881
			135	Willow Grove.	" 884
			138	Ripley Landing.	" 879

*Since the stereotypes were made of the foregoing pages of this chapter, (which had been edited by my father), Prof. White has furnished these additional lines and surveys. J. R. M.

87. *Errata in Note 45.* The statement in Note 45 with reference to the thinning away of No. XII. red beds in vicinity of Alderson, etc., was made upon information which I considered reliable at the time, but a subsequent personal examination shows that what was taken for the Pottsville conglomerate is simply a massive, white pebbly sandstone in the No. XI. shales and that instead of having thinned away, these shales are here thicker than anywhere else in the state, approaching 2,500 feet and holding two immense white conglomerates, along with the red beds and impure limestone. I. C. W.

The casting of the plate in which Note 45 occurs prevented the making of this correction in its proper place. J. R. M.

88. *Fairmount.* The levels are brought from Fairmount on main line of B. & O. by Major Whiting of the B. & O. engineer corps. The elevation here gives 779 feet for low water at Morgantown, but the river survey from Pittsburgh makes it 786 feet. See Note 21.

89. *Rievesville.* Sewickley coal crops out along railroad cuts.

90. *Little Falls.* Upper Freeport coal in cuts. Rapids in river made by Upper Freeport sandstone.

91. *Offington.* Mahoning s. s. makes great cliffs here known as "Raven Rocks."

92. *Morgantown.* Upper Freeport coal 75 feet under river. Pittsburgh coal 440 feet above same level. Fine show of terrace deposits extending to 275 feet above river. Good locality for fossils in crinoidal limestone. Cheat river gorge nine miles distant. Grand view from crest of Chestnut Ridge. Subcarboniferous fossils under great arch below.

93. *Camdensburg.* The Pittsburgh coal dips under the river about two and a half miles above Fairmount to about 50 feet below the same, but comes up just below Camdensburg and is soon 25 to 30 feet above water. Extensive coking works of ex-Senator Camden and others, 250 ovens. Coal 9 to 10 feet thick. This bed is never less than 8 feet thick between Fairmount and Clarksburg, and is of excellent quality for fuel, gas and coke. This road passes through one of the finest coal fields in the world, which must in the near future replace the Connellsville field.

94. *Ten Mile.* Upper Freeport coal in hills here and at the level of the track four miles below, near mouth of Grassy Run, where it is only 3 to 4 feet thick, but roofed with 12 feet of canal slate.

95. *Murraysville.* The Waynesburg sandstone is frequently seen between Parkersburg and Letout Falls, sometimes a great cliff as at Murraysville; again its top is just seen in the bed of the Ohio. At Letout it rises from the river to the northwest and makes the rapids in the river. Below here it forms long lines of cliffs near the summits nearly to Guyandotte.

96. *Graham.* Pittsburgh coal mined on the other side of the river by shaft 170 feet deep. Coal about 5 feet thick and dips rapidly southeast toward the center of the Appalachian basin.

97. *Hartford.* Hartford, Mason City, Clifton and the town of Pomeroy on the Ohio side are celebrated for the manufacture of salt and bromine. Salt bearing stratum reached by borings at about 1,150 feet under the Pittsburgh coal. It appears to be the top portion of the Pocomo (No. 1.) sandstone and the same as the Mt. Morris oil rock ("Big Intun.")

Ohio River Railroad.—Continued.		Alt.	West Virginia Central R. R.—Continued.		Alt.
			Ms.	Extension from Thomas to Elkins.	
chool House.	Perm. C'b., (XVI.)	574	74	Fairfax.	Barrens, (XIV.) 3051
stout.	"	576	78	Thomas.	Top L. Coal M., (XIII.)
raham. ⁹⁶	14 c. Up. C'l Meas.	574	79	Davis.	Low Kittanning Coal.
ew Haven.	P'gh Coal in riv.	576	80	Globe Falls.	No. (XII.) Congl. 2724
artford. ⁹⁷	Pittsburgh Coal.	573	81	Pt. Lookout. ¹⁰²	" 2640
ason City.	"	574	82	"	Top Mauch C'k Reds.
ifton.	"	574	84	Big Run.	No. (XI.) beds. 2150
. Columbia.	"	566	87	Hendrick's.	12. Catskill. 1720
mden. ⁹⁸	"	567	90	Black Fork.	11 b. Chemung. 1650
. Pleasant.	"	570	91	Shaver's Fork.	" 1648
. & O. June.	"	571	93	Haddix Run.	" 1680
allipolis Ferry.	Barrens, P'gh Coal.	577	98	Haddix Summit.	" 2179
en Lomond.	Barrens, (XIV.)	551	101	Montrose.	10 b. Hamilton. 1983
pple Grove.	"	570	106	Kerens.	" 1938
ercer's Bottom.	"	550	112	Old Leadville.	" 1912
lenwood. ⁹⁹	"	551	113	Elkins. ¹⁰³	" 1924
rown City F'y.	"	548	Survey, Elkins to Gauley River.		
reen bottom.	"	579	0	Elkins.	10 b. Hamilton. 1924
illiamsprt F'y.	"	567	6	Beverly.	" 1953
sage.	"	549	8	Burnt Bridge.	" (water.) 1939
xe's.	"	548	13	"	" 1974
uyandotte Jc.	"	546	16	Mill Creek.	" 2002
Proposed Branch.			17	Huttonsville.	" 2062
avenswood.	{ 15. Permo. Carb.		26	Elk Water.	11 b. Chemung. 2358
	{ Wash'gton Coal.	584	32	Brady's Summit.	No. (XI.) l. s. 2992
Iverton.	15. Permo. Carb.	580	34	Riggles.	No. (XI.) Shales. 2714
ndyville.	"	582	35	Red Lick Run.	Top (XI.) l. s. 2429
roy.	"	660	36	Elk River.	No. (XI.) Shales. 2331
nd Cr. Summit.	"	590	38	Whitacre's Falls.	" 2171
ree Forks.	"	671	39	Big Run.	" 2136
Reedy. ¹⁰⁰	"		46	Burgoo.	" 1904
edy Summit.	14 c. Up. Coal Meas.	905	48	Leatherwood.	" 1841
encer. ¹⁰¹	Barrens, (XIV.)	720	56	Elk River.	" 1583
Virginia Central Railroad.—Continued.			59	Addison. ¹⁰⁴	Top (XI.) l. s. 1463
Piedmont and Cumberland.			63	Payn's Summit.	Base of No. (XII.) 2456
umberland.	7. Low'r Helderb'g.	630	71	Gauley Riv. ¹⁰⁵	No. (XII.) Congl. 2308
awlins.	5 b. Clinton.	696	78	Williams Riv.	" 2215
lack Oak.	"	734	Stony River Survey.		
st Bridge. ⁷⁸⁶	10 b. Ham. (Mare'lus.)		0	Mouth of River.	No. (XII.) Congl. 2076
eyser. ⁷⁹⁵	7. Low'r Helderb'g.		6	Pike Cross'g. ¹⁰⁶	Barrens, (XIV.) 2545
esternport.	{ 14 a. Pottsville Congl.,		10	"	Low. Coal Meas. 2799
. Va. Cent. Jc.]	{ Top of (XII.)	915	13	Falls. ¹⁰⁷	Clarion Coal. 2977
			15	"	No. (XII.) Congl. 3102

Camden. Pittsburgh coal, 4 to 5 feet thick, mined here. It thins away down the river to 18 inches at Point Pleasant. Occasionally, as at Mercer's Bottom, it thickens to 4 or five feet, that it thins again to a few inches and not mined until near Huntington, where it is 3 to 4 feet. **Glenwood.** Here recently an attempt was made to sell lands as containing tin ore. The d tin is a brecciated lime-tone 40 to 60 feet below the Pittsburgh coal and on analysis proved contain a trace of tin. Another "tin syndicate" explored this same stratum for that metal on title Kanawha, nine miles above Grantsville.

Three Forks Reedy. The "Ridge Limestone" near the summits of the hills over a large part of Jackson county is often 10 to 20 feet thick, and is probably the Ninevah Limestone of Pennsylvania, the X. of Stevenson's Green county series.

Spencer. The Burning Springs or Volcano anticlinal passes along the valley of Spring bringing the Barren Measures to the surface. Pittsburgh coal is absent or but feebly represented in this portion of the state and especially along the line of the Volcano anticlinal everywhere.

Point Look Out. Grandest scenery in the Appalachian Mountains. The Black Fork of the cuts a canon 1,500 feet deep through the Back Bone Mountain range, which is capped by the Alle Conglomerate. The railroad grade down this gorge is 180 feet to the mile and it runs a rock shelf 300 to 400 feet above the river, which has a fall of 100 feet to the mile. The New coals are exposed along the railroad grade, both the Nuttall (2½ feet thick) and Quinnemont being recognizable. The Quinnemont and Five Creek beds are split into a half dozen thin. The whole Pottsville Conglomerate series is here over 100 feet thick.

West Virginia Central R. R.—Continued.			Gauley River.—C. & O. Survey.—Continued.		
Ms.	Survey, Elkins to Buckhannon.—Con.	Alt.	Ms.	Survey, Elkins to Buckhannon.—Con.	Alt.
7	Roaring Ck. ¹⁰⁸	14 c.Low. Coal M. ¹⁸⁶⁰	15	Peters. ¹¹¹	Top of (No. XII.) ⁸⁷⁹
10		" ²¹²¹	21	Carnifax Ferry.	No.(XII.)N't'l C'l. ¹³⁰⁸
11	Roaring.	Barrens, (XIV.) ²³⁸⁸	25	Hughes Ferry.	No.(XII.)Congl. ¹⁸⁴⁶
12	King's Ridge.	" ²⁴⁵⁰	29	Brock's.	" ¹⁵⁸⁹
17	Toll Gate.	" ¹⁸⁵¹	51	Beaver Creek.	" ¹⁸⁹⁴
18	Burnt Bridge.	Top Low. Coal M. ¹⁸⁴⁰	40	Cherry River.	14 a.Nuttall Coal. ¹⁷⁷⁷
21	White Oak S'm't.	Barrens, (XIV.) ²⁰³¹	43	Cranberry.	" ¹⁹¹⁵
27	Buck. R. Divide.	" ¹⁷⁴³	46	Stroud's Creek.	No. (XII.) Congl. ²⁰⁰⁹
32	Buckhannon.	" ¹⁴¹⁸	55	Williams River.	" ²¹⁶⁷
Elk River.			75	Laurel Fork.	" ²⁰¹¹
0	Charleston.	Base of Barrens. ⁵⁵⁶	80	Stony Creek.	" ³²²⁸
21	Big Sandy.	" ⁹⁹¹	85	Marlin's Bottom.	{ No. (XI.) or Greenb'r l.s.to Cherry R. ²¹²⁰
24	Queen's Sh'ls. ¹⁰⁹	" ⁶¹¹	Little Kanawha River.		
60	Big Otter. ⁷²⁶	Top of Low. C'l Meas. ⁷⁵¹	0	Parkersburg. ¹¹²	No. (XVI.)P'm-C'b. ⁵⁶⁸
70	Grove's Creek.	Barrens, (XIV.) ⁷⁵¹	2	Lock One.	" ⁵⁶⁴
80	Birch River.	" ⁷⁷⁰	14	Lock Two.	" ⁵⁷⁴
93	Little Otter.	" ⁷⁹⁴	22	Lock Three. ¹¹³	" ⁵⁸⁴
	Beall's Mills.	" ⁷⁹⁸	32	Lock Four. ¹¹⁴	No.(XIV.) Bar'ens. ⁵⁹⁸
100	Sutton. ¹¹⁰	" ⁸⁰⁶	43	Spring Creek.	" ⁶¹³
Gauley River.—C. & O. Survey.				Buffalo Rock.	(?) ⁶²⁵
0	Mouth.	Top of No. (XII.) ⁶⁵⁰		L'r Leading C'k.	No. (XVI.)P'm-C'b. ⁶³¹
5	M'th of 20-Mile.	Base of No. (XII.) ⁶⁶⁷			
10	Little Elk.	" ⁶⁹¹			

103. *Elkins.* The Tygarts valley in which the town is situated, is geologically a great arch, or rather two anticlinal axes which have come nearly together. These are the anticlinals which cross the B. & O. R. R. at Terra Alta and Mountain Lake Park respectively, having there a trough between them deep enough to catch the Lower Coal Measures, but here at Elkins the axes are less than a mile apart and the trough holds only the basal beds of the Chemung. On one side (west) of this double arch at Elkins, the Rich—Big Laurel Mt. rises to 3,500 feet above the sea, and on the other (east) Cheat Mt. attains a greater height, while both are crowned with the Pottsville Conglomerate, thus rendering the wide valley between, one of the most beautiful and picturesque in the country.

104. *Addison.* County seat of Webster county. On the summit of an anticlinal axis, which brings the top of the Greenbrier Limestone 40 feet above water level and exposes 800 feet of the Mauch Chunk Red Shales between the top of the limestone and the base of the Pottsville Conglomerate in the summit of the Mountain above. Near the crest of this arch at Addison a hole was once bored for oil many years ago, but at about 100 feet a strong stream of salt and sulphur water was struck, which still continues to flow and has attained much celebrity as a mineral water for medicinal purposes, especially for kidney troubles. Where the Gauley Turnpike crosses McGuire's Gap, opposite Addison, a coal bed 2½ to 3 feet thick has been mined only 20 feet above the Mauch Chunk red beds.

105. Near here on Land Run is the out crop of a coal bed 7 feet thick, of poor quality and it would seem to come at the same horizon as the Pocahontas or No. III. bed of the Flat Top region.

106. Capt. Joseph Parsons, chief engineer of the W. Va. C. R. R. who has kindly furnished all the elevations on that railroad and its surveys, states that the Lower Kittanning coal passes under Stony river about three and a half miles above its mouth and reappears at nine miles up. The center of the trough is near where the northwestern pike crosses Stony river, and here the Pittsburgh coal is in the summits of the hills just north from the river. This is the northern end of the Elk Garden Pittsburgh coal basin, since northward from here that coal misses the hills by only 50 to 100 feet for twenty miles, till it is caught in the Fairfax summit on the Cheat-Potomac Divide.

107. There is a large area of the lower Kittanning coal from here on down the river for four miles and it has a thickness of eight feet with its customary partings. It is forty feet above water at the Falls.

108. Half way between Roaring creek and Elkins the Tygarts Valley river cuts squarely through the great Rich-Laurel Mt. uplift and exposes a splendid section from the Hamilton up to the Lower Coal Measures. Along and in the vicinity of Roaring creek is a large field of the Upper Freeport coal where the bed has a thickness of 8 to 10 feet. The Freeport sandstone is very massive and pebbly along the lower part of Roaring creek and makes the numerous falls.

109. *Queen's Shoals.* A few miles above here the river bends southward and the Upper Freeport coal comes above water level, and keeps above the same till the stream turns northward above Clay C. H. There is a fine area of this coal on Big and Little Sycamore creeks. With this exception only the Barren Measures crop out along Elk between Sutton and its mouth, a distance of 100 miles, and as these beds have a greater thickness (800') here than anywhere else in the country, I have termed them the Elk River series.

110. *Sutton.* The Mahoning coal (about 100 feet above the base of the Barrens) crops 30 to 40 feet above river level and has been mined to a small extent, while at Frametown 15 miles below, the Pittsburgh coal is in the summits of the hills, 500 feet above the river and 6 to 7 feet thick.

111. From the mouth of the Little Elk up to the Cherry River the Gauley flows in a narrow cañon 300-400 feet deep, excavated out of the top members of No. XII., while the softer Lower Coal Measures occur back in the summits of the hills on the broad plateau at the top of No. XII. The Nuttall coal comes up at the mouth of Meadow River, but it thins there. It has a thickness of 5 to 6 feet on the waters of Hommony, Cherry and other streams, which put in from the south, and is a splendid coking coal.

Ms.	Little Kanawha River.—Continued.	Alt.
61	Down's Ripple. No.(XVI.)P'm-C'b.	645
63	Anna Maria C'k.	641
68	Big Root.	644
76	Pine Creek.	554
78	Grantsville. ¹¹⁵	556
80	Steer Creek. ¹¹⁶	566
85	Acre Island.	571
89	Musch Shoals.	577
92	Tanner Fork. ¹¹⁷	582
96	Cedar Creek.	587
98	3d Run Sh'ls. ¹¹⁸	589
101	Leaving Creek.	690
103	Glenville. ¹¹⁹	702
105	Stewart's Creek.	702
106	Mud Lick Run.	710
110	Sand Fork.	711
115	Stout's Mill.	723
118	Hyer's Run.	735
121	Oil Creek.	741
122	Burnsville. (Lumber port.)	741
	Bennett's Run.	752
131	Bulltown.	780

Kentucky.¹²⁰

Ms.	Chesapeake and Ohio Railroad.—Continued.	Alt.
	Cincinnati Division.	
504	Catlettsburg.	Low. Coal. (XIII.) ⁵⁴⁴
506	Williams.	"
509	Norton.	"
510	Ashland.	544
511	A. C. & I. Cr's'g.	"
512	Bellefonte.	14 a. Pottsv., (XII.)
515	Russell.	"
519	Wurtland.	"

Kentucky.¹²⁰

Ms.	Chesapeake and Ohio Railroad.	Alt.
	Cincinnati Division.—Continued.	
522	Riverton Jc.	14 a. Pottsv., (XII.)
523	Greenup.	13. Sub-Carboniferous.
528	Gray's Branch.	"
535	Siloam.	"
541	S. Portsmouth.	"
551	Quincy.	"
553	Kinney.	"
558	Buena Vista.	Huron Shale.
560	Fairview.	"
563	Vanceburg.	9 c. Cornif. l. s. in riv.
568	Rome.	5 c. Niagara.
575	Concord.	"
577	Pence.	4c. Cincinnati.
586	Springdale.	"
592	M. & B. S. Junc.	"
593	Maysville.	502
601	S. Ripley.	"
603	Dover.	"
610	Augusta.	"
614	Wellsburg.	"
617	Bradford.	"
621	Foster.	4 c. Cincinnati.
628	Belmont.	"
630	California.	4 a. Trenton.
632	New Richmond.	494
634	Oneonta.	"
638	Ross.	4 c. Cincinnati.
649	Dayton.	541
651	Newport.	"
653	K. C. Jc.	515
654	Covington.	"
655	Cincinnati.	"

112. *Parkersburg.* Low water here as given by Col. Roberts is 562.804. See Note 35.

113. The elevations given for these locks is the top of the mitre sill below the dams. From Parkersburg for 25 miles up the river the rocks are nearly horizontal and the Upper Meretta sandstone of the Permian Series, which is quarried at Parkersburg, (Jackson quarry,) makes cliffs in the river hills for a long distance. It is extensively quarried at Elizabeth.

114. *Lock Four.* Near here is Burning Springs, the famous oil district, from which oil was collected and marketed as far back as 1841. The Eureka Volcano Anticline (called the "Oil Break") passes through this region, and brings up 400 feet of the Barren Measures. The Pittsburgh coal is absent, or only a few inches thick, while the Crinoidal coal is 20 inches thick and mined below the village for local supply. Oil is obtained here in the Mahoning, Conglomerate, "Big Injun" (Pacora) and Maxburg (Gantz) sands.

115. *Grantsville.* Here the Waynesburg is in the summit of the hills.

116. *Steer Creek.* At the mouth of this stream the massive sandstone above the Pittsburgh coal comes above water level, and the base of the great Waynesburg sandstone cliff is 275 feet above the same.

117. *Tanner Fork.* Along this stream the Waynesburg coal is mined for local use. It is only 18 to 24 inches thick and at Tannersville 6 miles up the stream is 135 feet above the latter.

118. *Third Run Shoals.* The Waynesburg Coal shows in summit of hill here 360 feet above the river or 1060 A. T. The horizon of the Pittsburgh coal is about 50 feet above the river, but the coal is absent.

119. *Glenville.* A broad anticline, which is probably identical with the Chestnut Ridge axis, crosses the river above Glenville and hoists the Pittsburgh coal 225 feet above the same. This coal makes its first appearance here it being absent or but feebly developed everywhere below until its horizon dips under water near the mouth of Steer Creek; at one and a half miles above Glenville it is 4 to 5 feet thick and 200 feet above the river. It runs along the hills at near this level for a mile or two further and then dips rapidly down below water level, passing under the river 1½ miles below Land Fork or 109½ miles from Parkersburg. The sandstone above the coal has an immense development in this region, being 130 feet thick. The horizon of the Pittsburgh coal keeps 50 to 75 feet below river level till we come to Stout's Mills, when the basin is crossed and it begins to rise rapidly appearing 10 feet above river level, one mile above Stout's Mills, and one-half mile further up stream is 75 feet above the same. It is here 7 feet thick and there is a great coal field in this basin between Burnsville and Glenville.

120. This Division of the C. & O., (formations by Prof. I. C. White) belongs in the Kentucky chapter, but for lack of space is inserted here, just before publication. J. R. M.

Virginia.²³

BY PROF. WILLIAM B. ROGERS.

List of the Geological Formations Found in Virginia and West Virginia.

	GENERAL GROUPS.	SUB-DIVISIONS IN VIRGINIA AND WEST VIRGINIA.	Numbers marking the Paleozoic Formations of Penn. and Va., as used in the Annual Reports of W. B. and H. D. Rogers.	
Cenozoic.	QUATERNARY.	20. Quaternary.		Names adopted by H. D. and W. B. R. for the Paleozoic Formations of Pennsylvania and Virginia and used in H. D. Rogers' Final Report of the Geology of Pennsylvania.
	TERTIARY.	19 c. Pliocene. 19 b. Miocene. 19 a. Eocene.		
	UPPER AND LOWER MESOZOIC.	(18 & 17.) Jurasso-Cretac's. ¹ Upper Secondary s. s. (17, 16.) Jurasso-Triassic. ² Mid. Secondary Sandstones and Coal Measures.		
Paleozoic.	UPPER CARBONIFEROUS.	14 c. Upper Barren Group. 14 c. Upper Coal Group. 14 b. Lower Barren Group. 14 b. Lower Coal Group. 14 a. Great Conglomerate and Conglo. Coal Group.	XVI. XV. XIV. XIII. XII.	Seral. Seral. Seral. Seral. Seral.
	MID. CARBONIFEROUS. (UPPER SUB-CARB.)	13 b. Greenbriar Shales. 13 b. Greenbriar Limestone. (Carb. Limestone.)	XI. XI.	Umbral Shales. Umbral Limesto.
	LOWER CARBONIFEROUS. (LOWER SUB-CARB.)	13 a. Montgomery Grits and Coal Measures. (Tuedian ?)	X.	Vespertine Sandstone and Coal.
	DEVONIAN.	Names of N. Y. Survey chiefly: 12. Catskill. 11 b. Chemung. 11 a. Portage. 10 c. Genesee. 10 b. Hamilton. 10 a. Marcellus.	IX. VIII. VIII. VIII. VIII. VIII.	Ponent. Vergent. Vergent. Cadent. Cadent. Cadent.
	SILURIAN.	8. Oriskany. 7. Lower Helderberg. 6. Salina. 5 c. Niagara. 5 b. Clinton. 5 a. Medina.	VII. VI. V. V. V. IV.	Meridian. Pre-Meridian. Scalent. Scalent. Surgent. Levant.
	SILURO-CAMBRIAN ⁴ OR UPPER CAMBRIAN.	4 c. Hudson River. 4 b. Utica. 4 a. Trenton.	III. III. III.	Matinal. Matinal. Matinal.
	MIDDLE ⁴ AND LOWER CAMBRIAN.	3 c. Chazy. 3 b. Levis. 3 a. Calciferous. 2 b. Potsdam Group. ⁵	II. II. II. I.	Auroral. ⁴ Auroral. Auroral. Primal. ⁵
	ARCHEAN.	Archean. A, B, C, D. ⁶		

Virginia.			Ms. Chesapeake & Ohio Railroad.		Alt.
Baltimore and Ohio Railroad.					
Ms.	Harper's Ferry and Valley Branch.	Alt.			
0	Harper's Ferry. ²⁷⁷	Altered Cambrian (b) or Archæan B. followed west by Cambrian, 2 b., 3 a.	0	Richmond.	44 { W. outcrop of Tert'y and Upper Mesozoic, all resting on Arch. C.
1	Shenandoah. ²⁷⁷	Cambrian 3 a., b. " 8 b., c.	9	Atlee's.	202 19. Tertiary.
6	Halltown. ²⁸⁹		18	Hanover C. H. ²²	"
10	Charlestown. ²¹³		28	Hanover Junct.	{ Upper Mesozoic, Jurasso-Cretaceous.
14	Cameron. ²⁴⁷		33	Noel's.	257 1. Archæan, C.
28	Wadesville. ⁴⁹⁵	Siluro-Cam. 4 a. & 4 b.	40	Beaver Dam.	229 { Gneiss & Mica Slates, with veins of Gran.
27	Stephenson's. ⁴⁹⁹	{ Siluro-Cam. & Cam. 4 a. and 3 c.	45	Bampass'.	241 1. Archæan, A.
32	Winchester. ⁷¹⁷	The road runs close to boundary of Cambrian 3 c., and Sil.-Cambrian, 4 a., of the belt lying east, composed largely of 4 c.	50	Frederick's Hall.	" 251
36	Kernstown. ⁷⁴⁴		56	Tolersville. ¹⁰	463 { Mic. Hornb. & Hydro. Mic. Slat., with Auriferous q'tz. The gold belt.
39	Newtown. ⁷⁷⁰		62	Lousia C. H.	452 1. Archæan, C.
42	Vauchuse. ⁷		76	Gordonsville.	500 " B.
44	Middletown. ⁷⁰⁰	{ Siluro-Cambrian 4 a. and 4 b., on switch track.	81	Lindsay's.	437 { Argil. Mic. & Hydro. Mic. Slat., with patches of Slaty Limestone & Steatite Epidotic, Chlor. and Sil. Grits & Slates of S. W. Mt. followed west by Gneissoid Sandstone.
46	Cedar Creek. ⁶⁹⁵		83	Cobham.	393
50	Capon Road. ⁷⁴⁰		90	Keswick.	439
51	Strasburg Jo. ⁷⁰³		97	Charlottesville.	449
55	Tom's Brook.	Cambrian, 3 b., c.	104	Ivy.	544 1. Archæan, D.
57	Maurerstown.	" "	107	Mechum's River	Horn. & Chl. Gnei. Syen.
61	Woodstock. ⁸²⁰	" "	115	Greenwood.	{ 1. Arch., B. Bl. Ridge Epid. Chlor. Argil. Slates, & c., flank'd W. by Camb. 1, 2 b. Pots. Cambrian, 3 a., adjoining slates of 2 b. Sil-Camb., 4 a. & 4 b. Edge of slate belt. Camb. & Sil-Camb., 3 c. and 4 a.
66	Edinburg. ⁸⁴⁵	" "			
74	Mount Jackson. ⁹¹⁶	{ Cam. & Siluro-Cam. 3 c. and 4 a.			
81	New Market.	" "			
88	Broadway.	" "	124	Waynesboro.	1201
94	Linville.	" "	129	Fishersville.	1221
00	Harrisonburg. ⁸	" "	136	Staunton.	1337
105	Pleasant Valley.	Cambrian, 3 b., c.	144	Swoope's.	1645
117	Fort Defiance. ⁹	" "			
126	Staunton.	1866 { Cam. & Siluro-Cam. 3 c. and 4 a.			

1. The term Jurasso-Cretaceous is chosen to designate the Upper Secondary Sandstones of the Virginia reports and the associated sands and clays which in their prolongation, northeast through Maryland, Delaware and New Jersey, are found to underlie the Cretaceous green-sand formation of those States, because the fossils found in the vicinity of Fredericksburg, etc., in Virginia, as well as near Baltimore, suggest the upper stage of the Jurassic period; while it is stated that the sands and clays of this belt in New Jersey are referable to the base of the Cretaceous. The whole group would seem in the main to be one of transition, and it is probably best comparable to the European Wealden.

2. The name Jurasso-Triassic is preferred for the Mid-Secondary rocks of the Virginia reports, as it is thought to correspond best with the fossil indications thus far furnished by the several belts included in it. Of these, the most western area is in part continuous with the so-called Triassic belt of Maryland and Pennsylvania, and in part with the coal bearing rocks of Dan River, North Carolina. The middle belt is in the line of prolongation of the Deep River coal rocks of North Carolina, and the eastern belt, including the Grits and Coal Measures of Chesterfield, Henrico, etc., is topographically without a counterpart. The middle and eastern belts in Virginia, and the western tract in North Carolina, show a close agreement in their fossil flora, which in many particulars has a decidedly Jurassic character, and all three belts are connected by certain species of *Estheria*, *Candona*, etc., held in common. Collectively these beds represent most probably a group of deposits ranging through Upper Triassic, and Lower Jurassic time, and are in large measure of a transitional character.

3. In grouping the Lower Paleozoic formations, Sedgewick's classification is used, including as *Cambrian* and *Siluro-Cambrian*, all the formations from the base of the Paleozoic to the top of the Trenton period (4 c.), and as *Silurian* the succeeding formations to the top of the Oriskany (8); these corresponding in limits to the Upper and Lower Silurian periods of the table.

4. The Middle Cambrian, or Auroral group, occupying much of the surface of the great valley west of the Blue Ridge, and exposed in numerous anticlinals and faults in the mountain belt farther west, is marked by a great preponderance of magnesian limestones in the lower two-thirds of its mass, passing below in many cases into Arenaceous and Argillaceous limestones, and followed above by oolitic and by cherty and sandy beds—these latter giving place still higher to the

Ms. Chesapeake & Ohio R. R.—Con. Alt.			Ms. Chesapeake & Ohio R. R.—Con. Alt.		
150	North Mountain. ²⁰⁷⁴	Devonian, 10 a., adjoining Silurian of the Gap, 5 a., 5 b. to 8, inverted.	195	Jackson's River. ¹¹³⁸	Devonian, 10 a., west side of Rich Patch Anticlinal Silurian, 5 a. to 8.
159	Craigsville. ¹⁵¹⁸	Silurian, 7. Encrinal Marble. 8. Oriskany.	205	Covington. ¹⁴³⁸	Devonian, 10 a. & 10 b., between southwest end of Warm Spring Anticlinal, & northeast end of Peter's Mountain.
168	Goshen. ^{11 1410}	Devonian, 10 a. and 10 b., between ridges of Silurian, 5 a. to 8.	221	Alleghany. ²⁰⁶⁸	Devonian, 10. to 12, enclosing, near tunnel, belt of Sub-Car. 18 a. Vespertina.
175	Millboro. ^{12 1679}	Devonian 10 a., near S. of Sideling Hill.			

more purely Calcareous and Argillo-Calcareous strata appertaining to the base of the Siluro-Cambrian, Trenton, or Matinal group. The frequent faults, inversions and repetitions of the beds in the great valley, and the rarity of fossils in the Auroral rocks, have interfered with a precise demarcation of formations, but there can be little doubt, from fossil and other evidence, that they cover the period of the formations 3 a., 3 b., 3 c., assigned to them in the Table. Hence, and as indicating the formations near as well as at the localities, the designation 3 a. b. will be used for these rocks up to the top of the magnesian, without distinguishing between Calcareous and Quebec (or Lewis), and 3 b. c., for the remaining strata up to the well defined base of the Siluro-Cambrian, Trenton or Matinal group, 4 a. b. and c.

5. The Potsdam, or Primal group, includes in Virginia, where complete, besides the Potsdam proper, the ferriferous shales next above, and the slates, shaly grits and conglomerates, below this formation. It is exposed in varying mass and completeness on the western slope and in the west flanking hills of the Blue Ridge throughout much of its length, often, by inversion, dipping to the southeast, in seeming conformity beneath the older rocks of the Blue Ridge, but often, also resting unconformably upon or against them. These older rocks, comprising masses referable probably to Huronian and Laurentian age, include also a group of highly altered beds, corresponding apparently to the copper-bearing or Keweenaw series of Northern Michigan, and perhaps to the lately described Dimetian rocks of Wales.

6. The letters A, B, C, D mark four rather distinct groups of Archean rocks found in Virginia, of which the first three may probably be referred to the Laurentian, Huronian and Montalban periods respectively, and the fourth to an intermediate stage—the Norian or Upper Laurentian.

7. This belt of Siluro-Cambrian slates extends continuously from the Potomac River to a point about ten miles south of Staunton, a distance of 140 miles, beyond which it becomes narrow and discontinuous. In the tract corresponding to the interval, from Strasburg to Harrisonburg, it encloses the complex synclinal of the Massanutten Mountains, consisting of massive ranges of Silurian rocks 5 a. 5 b., with some bands of 7 and a few traces of Devonian 10 a., all resting in the wide undulated trough of the slates. From Strasburg southwest, the railroad keeps generally a distance of from one-half to one mile west of the edge of the slates, but sometimes impinges upon it, affording ready access to fossiliferous beds of 4 a., b. and c.

8. About 13 miles west-by-north from this are the Rawley Springs, and a few miles farther the remarkable fissured rocks known as Moravian Town, both in Potomac 12. West-by-south, about 20 miles are the Dora coal mines, in Vespertine 13 a., of Narrowback mountain—anthracite, faulted and crushed. The irregular fault, which, with many interruptions, extends from near the Potomac River along the northwest edge of the Great Valley in the line of the Little North Mountain for about 120 miles, is seen near these localities to bring the Siluro-Cambrian 4. of the valley into juxtaposition with the Devonian 10. to 12.

9. About eight miles east of this are Weyer's and Madison's caves, situated in a ridge of steep dipping limestone, 3 a. b., near the South River.

10. In this part of the gold belt are situated the old workings, known as Tinder's, Boxley's, Baker's, Triple Fork and Walton's Mines.

11. This is a good point of departure for examining the rock structure of Panther Gap, 5 a. b., mostly inverted, and the wild passage of the North River through the same formations at Strecker's Gap, "The Goshen Pass." About 10 miles southwest are the Rockbridge Alum Springs, in 10. a. b.

12. About three miles north of this, on the Cow Pasture River, is the Blowing Cave of Bath County, in an anticlinal of 8. Oriskany; and twelve miles farther north-by-west, near the same river, is the noted intermitting stream called the Ebbing Spring, in a ridge of 7 and 8, on east side of Tower Hill, east of Warm Spring Axis. Twelve miles southwest to Bath Alum Springs, in 10 a., and thence 5 miles to Warm Springs, 3 c-4 a.

13. Where traversed by the Jackson's River, this anticlinal shows itself as a great arch built up of the successive concentric beds of 5 a. b. c., and flanked by 7. and 8., followed by 10 a., and having a span, as measured by the highest sandstone bed, of about 3,300 feet. The main arch, 5 a. Levant, or Medina, white sandstone, is regular and unbroken, but the outer concentric belts, made up of the hard members of 5 b. c., are distorted and in part inverted on the west side of the axis, where by a slight fault the beds of 7, pass suddenly from a nearly vertical to a horizontal position. Towards the southwest, this axis opens to form the Rich Patch Valley, bringing to view the Siluro-Cambrian 4 a., b. c., and still farther southwest becomes the closed anticlinal known as the Pott's Creek Mountain. Heavy beds of iron ore (Hematite) have been opened on both sides of this axis, as at Roaring Run, Callie's, Low Moor, and Kayser's near Clifton Forge, associated with formation 8. Oriskany. The fossil ore of 5 b. is also mined at several points.

West Virginia. ²²			Virginia.		
Ms. Chesapeake & Ohio R.R.—Con. Alt.			Washington City, Virginia Midland and Great Southern Railroad, now Virginia Midland. Alt.		
227	White Sulphur Springs. 1920	{ Devon., 10 a. & 10 b. Spring issues from 8.	0	Alexandria.	20. Quat. drift on denu.
238	Ronceverte. 1660	{ Lower Sub-Carb., 13 a. Vespertine.	5	Alex. & Fred'b'g Crossing.	{ Upper Mesozoic, Jurassic-Cretaceous.
244	Fort Spring. 1625	{ Upper Sub-Carb., 13 b. Umbral lim'tone.	9	Springfield.	1. Archæan, C. 340
251	Alderson. 1550	{ Upper Sub-Carb., 13 b. Umbral shale.	14	Burke's.	" A. 348
263	Talcott. 1510	"	18	Fairfax.	" A. 342
272	Hinton ¹⁵ 1377	{ Upp. Sub-Car., overlaid west by Congl. Coal group 14 a.	21	Clifton.	" A. 170
		{ Upper Sub-Carbon. shales, overlaid by Conglo. Coal group 14 a. The shales disappear west near Buffalo Creek.	27	Manassas Junct.	Mes., 17-16 Jur.-Tri. 317
294	Quinnimont. 1196	{ Congl. Coal gr'p 14 a.	81	Bristoe.	" 190
		{ Great Conglo. overlaid by Lower or main Coal group, 14 a. and 14 b.	84	Nokesville.	" 270
324	Hawk's Nest. 823	"	89	Catlett's.	" 250
326	Cotton Hill. 796	"	41	Warrenton Junc.	" 265
383	Kanawha Falls. 672	{ Main Coal group, 14 b.	44	Midland.	" 321
352	Coalburg. 625	"	47	Bealton.	" 290
359	Brownstown.	" 608	51	Rappahannock.	" 275
368	Charleston.	" 602	56	Brandy.	" 359
381	St. Albans. 594	Low. barren gr'p, 14 b.	62	Culpeper.	403 " W. margin.
395	Hurricane.	" 583	69	Mitchell's.	306 " S. margin.
401	Milton.	" 586	74	Rapidanne.	506 1. Archæan, B.
409	Barboursville.	" 580	79	Orange.	88 Madison. 395 { Argil. Mic. & Hydro. Mic. Slates, with patches of Limestone & Steaschist E. of S.W. Mt., followed by Epidotic and Chloritic Quartzites & Slates of S.W. Mt. & thence W. by Gneissoid Gr'ts.
416	Guyandotte.	" 580	89	Gordonsville.	495 {
421	Huntington.	" 566	93	Lindsay's.	477 {
			96	Cobham.	401 {
			102	Keswick.	436 {
			105	Shadwell.	308 {
			110	Charlottesville.	450 {
			111	Lynchburg Junc.	1. Archæan, D.
			119	Red Hill.	"

14. The Anticlinal Valley, which includes the group of thermals known as the Warm, Hot, Healing, etc., Springs, closes up about ten miles northeast of this, and its axis subsides towards the southwest in broad spurs which reach the river a few miles below Covington, in low arches of 7. and 8., overlaid by 10. The heated waters issue at numerous points throughout a distance of thirty miles; from Cambrian and Siluro-Cambrian rocks, 3. c., 4 a., usually inverted and often faulted along the west side of the valley, the eastern boundary of which it formed by the massive Warm Spring Mountain, 5 a. 5 b., dipping east, while its western limit consists of a narrow, broken ridge of the same formations in a vertical or inverted position. Stages to Healing, Hot and Warm Springs, severally 15, 19, and 22 miles. Near the first is the Cascade (200 feet) of Falling Spring Creek, which, cutting through the west wall of the anticlinal, flows over a mass of calcareous tufa, deposited from the waters.

The anticlinal of Peter's Mountain, rising a few miles northwest of Covington and exposing at the tunnel 7. and 8., expands towards the southwest, until it opens out into the valley of the Sweet Springs, containing another group of thermals of lower temperature than the preceding. This anticlinal, extending southwest, does not close up, but passes into the great Peter's Mountain and East River Mountain fault, which for a distance of fifty miles brings the Cambrian in contact with the Vespertine and Umbral formation, Sub-Carb., 13 a., 13 b.

15. The Upper Subcarboniferous, or Umbral Shales, here include a considerable thickness of brown and gray flaggy sandstone, the same which forms the hard rock of Swope's Knobs.

16. About 20 miles northwest of this point (by canal or road) we enter the gorge by which the James River traverses the Blue Ridge, where are exposed fine sections of Archæan rocks, A and B, and of the Cambrian, Primal 2 a., resting unconformably on the western slope of the former, and occupying the flanking ridges, which adjoin the valley. The Natural Bridge, the remnant of a former tunnel or cave in 3 a. b., is about 8 miles northwest from the upper end of the gap.

17. A few miles east of this, between Bannister and Dan Rivers, is a small patch of Jurassic-Triassic rocks, 18-17., corresponding to the Farmville or Middle belt, (see note 2), and containing *Estheria*, etc.

18. This deposit, made up largely of Diatoms, lies near the base, but within the limits, of the Miocene Tertiary. It contains occasional casts of Miocene shells, and is generally overlaid by beds of this formation, and rests either upon or but little above the top of the Eocene. Having formerly traced this deposit from the Patuxent River in Maryland to the Meherrin in Virginia, I have lately found by an examination of the artesian borings at Fortress Monroe, that a similar

Washington City, Virginia Midland and Ma. Great Southern R. R.—Con.			Alt.	Richmond, Fredericksburg and Potomac Ma. Railroad.			Alt.
127 North Garden.	From one and a half miles west of Charlottesville to near Lynchburg the prevailing rocks are Syenite, Granite, Protogine, Mic. Chlo. Gneiss. Near base of S.W. Mt. are belts of Gneiss'id sand and steaschist. Mic. & Hor., Sl. & Tr'p.			Washington.	(Steamboat.)		
127 Coveseville.			0 Quantico.	{ Upper Mesozoic, "	11		
181 Fabers.			5 Richland.		" "	10	
183 Rockfish.			12 Brooke's.	{ " Patches of "			
187 Elmington.			14 Potomac Run.		19. Tertiary on denuded surface. "	11	
140 Lovington.			21 Fredericksburg.	{ " Resting on gneiss at Falls. "			
146 Arrington.			38 Guiney's.		19. Tertiary.	100	
149 Tye River.			42 Milford.	" "	94		
152 New Glasgow.			47 Penola.	{ 20. Quaternary, gneiss coming to surface. "			
157 Amherst.			58 Rutherglen.		203	Jurasso-Cretac., 17-18	
163 Melvor's.			58 Junction.		" "	119	
166 Burford's.		1. Archæan, C.			60 Taylorsville.		
171 Lynchburg. ¹⁶	" B.	529		65 Ashland.	221	{ 20. Quaternary, gneiss coming to surface. "	
177 Lucado.	" Micaceous & Argil. Slates, includ'g patches of Limestone & Steatite, Epidotic & Chloritic Quartzites.	730		82 Richmond.		(Same as before.) ¹⁴	
182 Lawyer's Road.	1. Archæan, C.	668		84 Manchester Crossing.		{ 20. Quaternary, on decomposing gneiss, Archæan, C.	
188 Evington.	"	730		87 Temple's.		" "	
192 Otter River.	"	730		90 Drewry's Bluff.		" "	
195 Lynch's.	"	730		93 Halfway.		" "	
199 Staunton River.	"	730		95 Chester.	143	{ W. limit of Upper Mesozoic and 19. Tertiary.	
205 Sycamore.	"	730		98 Port Walthall J.		" "	
209 Ward's Springs.	"	812		105 Petersburg.	70	E.outc. of Gne. Arch. C.	
215 Whittle's.	{ Mesozoic, 17-16. Jur. asso-Trias'c, W. mar.	812		115 Ream's.	71	" "	
220 Chatham.	"	824		127 Stony Creek.	74	Gne. higher up, on cr'k	
226 Dry Fork.	"	824		135 Jarratt's.	154	{ Gne. short distance W. Tertiary ditto E	
230 Fall Creek.	"	824		147 Bellefield.	107	19. Terti. short dist. E	
236 Dundee.	1. Archæan, C.	413		154 Greensville Jun.		" "	
237 Danville.	"			164 Pleasant Hill.		" "	
Manassas Division.				168 Weldon.	108	E.outc. of Gn. in Riv. C.	
0 Alexandria.	(As before.)			Piedmont Air Line Railroad.			
27 Manassas Ju. ¹⁷	Mes., 17-16. Juras-Tria.			0 Richmond.	83	(Same as before.)	
36 Gainesville.	"	837		2 R. F. & P. Junct.		" "	
38 Haymarket.	"	837		22 Powhatan.	320	W. edge of Mes. cl. field.	
40 Thoro'ghfare.	{ 1. Archæan, B, Slaty Quartzite, Epid. Chl. Argil. & Mic. Slates or Bull Run and Pond Mountains.			36 Amelia C. H.		1. Archæan, A.	
44 Broad Run.	"			58 Burkeville.		" "	
49 Plains.	1. Archæan, C.	565		73 Keysville.		" "	
54 Salem.	"	583		90 Roanoke.		" "	
60 Rectortown.	" B.	444		101 Scottsburg.		" "	
63 Delaplane.	"	455		109 Boston. ¹⁷		1. Archæan, C.	
67 Markham.	"	552		127 Barksdale.		" "	
72 Linden.	"	916		136 Ringgold.		" "	
76 Happy Creek.	"	790		141 Danville.		" "	
79 Front Royal.	Cambrian, 3 a. Calcif.			156 Ruffin, N. C.		" "	
81 River.	Sil. Camb. 4a. & b. Tr. & Ut. 4 c. Hudson Riv'r.						
85 Buckton.	{ Fort Mt. Synclinal (5 a. & b.) ends near.						
86 Water Lick.	" 4 a. & b. Tr. & Ut.						
90 Strasburg.	"	694					
91 Strasburg Juc.	"						

deposit exists in that region at the depth of 558 feet below the surface, overlaid by Miocene and Pliocene beds, and resting upon an Eocene deposit identical with that which underlies it at Richmond. We are thus assured of the great extension seaward of this deposit, and have the means of estimating the thickness of the Tertiary formations as far east as the mouth of the James River.

Richmond, York River and Chesapeake			Norfolk and Western R. R.		
Sta.	Railroad.	Alt.	Sta.	Continued.	Alt.
0	Richmond. ¹⁸	(Same as before.)	191	Concord.	1. Archæan, B. 522
7	Fair Oaks. ¹⁶²	At Richmond tunnel cuts Tert'y Infusorial bed, 19 b. Miocene.	204	Lynchburg.	" 529
18	Dispatch. ⁶⁷	In this interval both Lower and Upper 19. Tertiary are accessible above tide level.	215	Forest.	1. Archæan, A. 577
15	Summit.	Eocene and Miocene.	229	Liberty.	" 569
20	Tunstall's. ⁶⁰	In this interval, only Upp. 19. Tertiary is accessible above tide level. 19 b. Miocene.	241	Buford. ¹⁰¹⁴	2-4 Cambrian, 3 a. Cal. 8 a. b.
24	White House. ¹⁸		246	Blue Ridge. ¹²⁹⁸	" 8 a. b.
26	Fish Haul. ⁴⁴		251	Bonsack's.	" " 922
31	Sweet Hall. ⁴⁰		254	Gish's.	" " 922
38	West Point. ⁹		252	Big Lick. ⁹⁰⁷	" & Sil-Camb'r'n.
			264	Salem. ¹⁹	" 3c & 4a Ch. & Tr.
			277	Big Spring.	" " 1762
			281	Alleghany. ¹²⁸⁰	" 3 b. c.
			285	Big Tunnel.	" " 1920
			290	Christiansb'g. ²⁰	" " 2012
			301	Central. ⁶⁵	" " 1755
			302	New River.	" " 1757
			309	Dublin.	" " 2066
			316	Pulaski. ⁶⁶	1919 { Fault of Draper's Mt. Silurian & Devonian against Sub-Carbon.
0	Norfolk.	{ 20. Quaternary, resting on Upp. Tertiary 19 c. Pliocene.	329	Max Meadows. ²⁰²⁸	2-4. Camb. 3 b. c. 2242
23	Suffolk.	Up. 19. Ter. & 19b. Mioc.	337	Wytheville. ²¹	" " 2575
34	Windsor.	" 84	350	Rural Retreat.	" & Sil-Ca., 3c. & 4 a.
41	Zuni.	" 8	364	Marion. ²¹⁸⁶	" " 2088
45	Ivor.	" 87	380	Glade Spring. ²²	" " 2069
52	Wakefield.	" 100	393	Abingdon.	" " 1689
60	Waverley. ¹¹⁴	{ Lower 19. Tertiary here probably above tide level.	408	Bristol, Tenn.	Continued as East Tennessee, Virginia & Georgia Southwestern Railroad.
68	Disputanta.	" 117			
81	Petersburg.	{ E. marg. of 19. Tertiary & U. 17-18 Mes. resting on Gneiss, C.			
96	Church Road.	1. Archæan, C. 303			
101	Ford's.	" 307			
108	Wilson's.	" 367			
112	Wellville.	1. Archæan, A. 420			
118	Blacks & Whites.	" 425			
124	Nottoway C. H.	" 421			
138	Burkeville.	" 523			
141	Rice's.	" 596			
149	Farmville. ³¹⁶	{ 16. Mesozoic, 17-16. Jurassic-Triassic.			
161	Prospect.	1. Archæan, A. 575			
169	Pamplin's.	" 673			
181	Appomattox.	"			

19. From this point, for many miles towards the southwest, the railroad runs near to and almost parallel with the broken synclinal, (about 25 miles long), of which the lofty Catawba and Fort Lewis Mountains are the principal parts. The former, composed of southeast dipping 4 a. b., etc., forms the farther or northwest rim of the synclinal, and bending abruptly around at its northeast end, becomes the Tinker Mountain, which closes the basin in that direction. A shorter and gentler bend at the southwest end, terminates in a fault. The corresponding rocks of the southeast, or near side of the synclinal, are only partially preserved in a narrow inverted ridge at either end, the remainder of this rim of the synclinal having been engulfed in the prolonged fault, which, for many miles along the margin of the basin, has brought the Siluro-Cambrian rocks (4 a. c.) of the valley to abut against, and over-ride the Devonian 10. to 12. and the Vespertine 13 a., of which the Fort Lewis Mountain, the central mass of the synclinal, is mainly composed.

20. A few miles west-by-north of this is an area of Vespertine rocks, 13 a., including one or more workable beds of coal, mined on Strouble's Run and elsewhere. This area once probably continuous with the Vespertine of Fort Lewis Mountain, is almost encompassed by faults. Farther to the northwest, and separated from the above by a belt of Cambrian and Siluro-Cambrian rocks 3 c., 4 a., etc., the Vespertine beds of the southeast slope of the Brushy Mountain, contain a similar coal, mined on Tom's Creek, etc., all these seams being more or less affected by the neighboring faults. The dislocation which, southeast of Brushy Mountain, brings Vespertine and Umbrial in apposition with Siluro-Cambrian Matinal, is part of the great fault which, with some change of direction and character, extends along the northwest edge of the great valley, from near the James River to the end of the Brushy Mountain, northeast of Abingdon, a distance of about 125 miles.

Washington, Ohio and Western Railroad.			Washington, Ohio and Western Railroad.—Con.		
Ms.		Alt.	Ms.		Alt.
0	Alexandria.	(Same as before.)	17		
7	Carlin's.	"	27	Guilford.	415 { Mesozoic, 17-16 Jur- asso-Triassic.
11	Falls Church.	1. Archæan, C.	31	Farmwell.	" 330
15	Vienna.	1. Archæan, A.	38	Leesburg.	" W. mar. Cong. 321
18	Hunter's.	"	42	Clark's Gap.	1. Archæan, B. 345
21	Thornton.	1. Archæan, B.	45	Hamilton.	" 454
23	Herndon.	{ Mesozoic, 17-16. Jur- asso-Triassic. 395	49	Purcellville.	" 555
			52	Round Hill.	" 555

At a distance of 23 miles, in a northwest direction, is the sheet of water called "Mountain Lake," situated near the top of Salt Pond Mountain, at a height of 4,000 feet above tide. Here the Potomac and Johns Creek Mountains and the other ridges of 5 a. b. coalesce at their southwest termination, into a lofty rugged table-land, overlooking the New River, and commanding wide views.

21. A few miles south, the Lick Mountain range divides the valley for some miles into two and in the southern of these belts, on the New River, below the mouth of Cripple Creek, are the Austenville lead mines, in 3 b., near the Primal 2 b. of Popular Camp Mountain, and about 15 miles distant from Wytheville.

22. From this point a short branch railroad leads north into the valley of the north fork of the Holston River, between Walker's Mountain, 5 a., etc., and Poor Valley ridge, Vespertine 13 c., etc., which flanks the Clinch Mountain on the southeast side. Here, near Saltville, are the remarkable salt wells, which penetrate into a thick mass of rock-salt; and in the same vicinity, and at various points higher up the valley, for a distance of 20 miles, beds of gypsum have been opened and extensively wrought. These deposits are found near and in a line of fault, along which the Siluro-Cambrian 3 c. 4 a., of the southeast side of the valley, has been made to abut against and sometimes over-ride the Umbral 13 b., which, with the Vespertine 13 a. of the Poor Valley Mountain, form a belt on the northwest side of the valley. Both deposits are most probably referable to the Subcarboniferous period. The fault here spoken of extends, with some local changes of character and direction, in a west-by-southwest course, from a point in Giles county to the Tennessee line, a distance of 125 miles, and is prolonged many miles into Tennessee. WILLIAM B. ROGERS.

23. So few details have been published on the geology of Virginia, that no chapter in this volume will be more welcome to geologists than this, which has been wholly and very carefully prepared by Professor William B. Rogers, late State Geologist of Virginia. J. M.

NOTE TO THE SECOND EDITION.—The first seven pages of this chapter are from the first edition without material change, except the addition of the altitudes. The larger portion of the Baltimore and Ohio is given again in the succeeding pages, with notes by Prof. J. L. and H. D. Campbell, and the portion of the Chesapeake and Ohio in West Virginia, will be found more fully described in the chapter on that state.

Chesapeake & Ohio Railroad.*			Brighthope Railway.*		
Ms.	Peninsula Extension.	Alt.	Ms.		Alt.
0	Richmond. ²⁴	(Same as below.) 44	0	Winterpock.	17. Jurassic, 16. Trias.
2	Orleans Street.	{ 20. Quaternary and 19. Tertiary. 38	8	Summit.	{ Margin of 7. Juras., Triassic, and 1. Laurentian.
18	Roxbury.	{ 20. Quaternary and 19 b. Miocene. 31	14	Fendley.	1 a. Laurentian.
24	Providence Forge.	" 29	22	Chester.	{ 20. Quaternary, base of Eocene near by. 143
82	Lanexa.	19 b. Miocene. 21	33	Bermuda.	20. Quaternary.
88	Toano.	{ 20. Quaternary and 19 b. Miocene. 101	Richmond & Alleghany Railroad. †		
48	Williamsburg.	19 b. Miocene. 66	0	Richmond. ²⁴	{ W. margin Tertiary, Mesozoic, 18, 19. 33
57	Lee Hall.	20. Quaternary. 38	5	Korah. ²⁵	1 a. Granite. 106
69	Morrison.	" 38	7	Westham.	" 116
75	Newport News.	" 5	12	Lorraine.	17. Jurassic Coal. 142
Baltimore & Potomac Railroad.*			13	Vinita.	17. Mesozoic. 142
0	Washington.	{ 20. Quaternary, and 17. Jurassic, 18. Cretaceous. 35	17	Manakin.	" 141
2	Long Bridge.	" 35	19	Boscobel. ²⁶	17. Nr. marg. Meso. 143
7	Alexandria.	" 35	20	Dover.	" 143
18	Franconia.	{ 17. Jurassic. 18. Cretaceous. 234	25	Lee's.	1 a., 1 b. Archæan.
17	Long Branch.	" 82	30	Maiden's Ad. ²⁷	{ 1 a. In River. 143 1 b. On Hills. 159
24	Woodbridge.	" 73	33	Cedar Point.	" 159
80	Cherry Hill.	" 7	34	Irwin.	" 159
34	Quantico.	" 16	40	Rock Castle.	" 175
116	Richmond.	{ Junction of 1. Laurentian, 17. Juras., 18. Cretaceous, and 19. Tertiary. 84	42	Stokes.	" 190
			47	Pemberton.	" 198
			52	Elk Hill.	" 198
			54	Elk Island.	" 198

* By Professor William M. Fontaine, of the University of Virginia.

† By Professors J. L. and H. D. Campbell, of Washington and Lee University, Lexington, Va.

24. *Richmond* is on the west margin of the Mesozoic and Tertiary belt. (See Rogers Note 18.) These formations may be seen in railway cut near Tredegar Iron Works, at the York River Railway station, and on the margin of Shocco Creek, near the Medical College. The bed of the river is gneissoid granite at the city, and for several miles above.

25. At *Korah* large quantities of granite, doubtless of Laurentian age, are quarried for shipment. Another large quarry is opened opposite Westham, on south side of the river. Between Westham and Lorraine the road passes from the Archæan to the Mesozoic coal-bearing beds (17, 18), and continues on them for about 10 miles to Dover.

26. *Boscobel*, or *Dover*, near the west margin of the coal field, is near the old Dover Mines. Fossils in the debris of the coal slates.

27. Between this point and Goochland C. H., a mica mine was formerly worked (in 1 b.), but not exhausted.

[N. B.—In our notes on the Archæan rocks, we recognize only *Laurentian* (1 a.) and *Huronian* (1 b.); and even the horizon between these is uncertain in this part of Virginia.]

28. At *Columbia* a granite quarry is worked in 1 a., overlaid by mica and hydro-mica slates and schists of 1 b. This is the best point from which to visit the several gold mines in the vicinity.

29. *Bremo Bluff* is a good point of departure for examining several objects of interest. (a) "The Bluff," near the station, is apparently a closed anticlinal fold of beds of hard gneissoid sandstone and arenaceous slates, nearly vertical in position. A second bluff of the same general structure occurs about 200 yards farther up the river. The syncline between them and outside flanks of both are occupied with argillaceous slates. The same ledges appear on the opposite side of the river. (b) At this point a branch (Buckingham Branch) railway crosses the river to extensive slate quarries, about five miles distant, and apparently in the same formation (1 b.) as the slates about the "Bluff." Future explorations may modify this view. (c) Willis Mountain, about 20 miles east of this station, is an isolated mass of gneissoid rocks, containing numerous crystals of kyanite of different shades of color, and of hornblende and tourmaline, with other minerals. (d) This is one of the best portions of the gold belt. Iron ores—limonite, hematite and magnetite—abound here.

30. From *Richmond* to *Scottsville* the road cuts the strata by a route generally at right angles, or nearly so, to their strike; and for several miles below the town the outcroppings, mostly of 1 b., show frequent changes of dip, and are occasionally nearly horizontal. The route here changes towards the southwest.

Richmond & Alleghany Railroad—			Richmond & Alleghany Railroad—		
Ms.	Continued.	Alt.	Ms.	Continued.	Alt.
57	Columbia. ²⁸	{ 1 a. Granite, 1 b. Mica Schists. 206 Gold Belt. 206	181	Stapleton. ³²	1 b. L. S. Spec. Ore. ⁴⁴⁷
63	Boswell.	1 a., 1 b. Archæan. 213	183	Galtville.	{ Mica Schists, Spec. Ore. 455
67	Bremo Bluff. ²⁹	{ 1 b. Gneissoid Sand s. and Slates. 221	186	Joshua Falls.	1 b. Archæan, Limestone and Ores. ⁴⁵⁵
70	Middleton Mills.	1 b. Archæan. 221	147	Lynchburg. ³³	{ 1 a., 1 b. Gneiss, Mica, Slate. 559
73	Hardware.	{ 1 b. Archæan, Schists and Slate. 266	148	Va. Mid. Junc.	" 559
75	Payne.	" 266	149	Smith's Lock.	" 559
80	Scottsville. ³⁰	" 275	151	Rolling Mill.	1 a. b. Archæan. 559
83	Brown's.	16. Marg. Mesozoic. 291	159	Bethel.	" 563
86	Warren.	16. Mesozoic. 299	159	Holcomb Rock.	" 563
91	Howardsville. ³¹	" 215	.....	Pedlar's.	" 571
96	Manteo.	1 b. Archæan. 224	161	Coleman's Falls.	" 571
99	Warminster.	{ 1 b. Archæan, Limestones & Schists. 252	166	Big Island.	" 596
102	Wingina.	" 350	.....	Jordan.	1 a. and 2. a b. Margin.
105	Norwood.	"	170	Rope Ferry. ³⁴	{ 2 a. b. Cambrian, (Potsdam) Sandstone, Slate. 663
109	Buffalo Springs.	"	175	Balcony Falls. ³⁵	" 701
114	Greenway. ³²	{ 1 b. Limestone, Spec. Ore. 288	178	{ Glenwood. ³⁶ Nat. Bridge.	3 b. L. Silurian. 715
118	Gladstone.	" 299	189	Indian Rock. ³⁷	{ 3 b. L. Silurian, near 4 a. 720
123	Riverville.	" 423			

31. About three miles below *Howardsville* the river and road cut into the lowest beds of a Mesozoic trough, or oval basin, that covers several square miles of area, the larger portion on the north side of the river. The remarkable coarse conglomerate that forms the base of this series of rocks is well exposed in contact with Archæan rocks along the banks of Rockfish River, near the station, and along a little stream running through the neighboring village, while the overlying ferruginous sandstones and slates appear in the surrounding hills. After passing this Mesozoic tract, the route, following the windings of the James River, keeps within the general trend of a belt four or five miles wide, in which are several beds of limestone and ores of iron imbedded in still heavier strata of micaceous, talcose and chloritic slates and schists, all most probably of Huronian age. After following this limestone and ore belt for about 40 miles, the bearing is abruptly changed toward the northwest about six miles below Lynchburg.

32. At points between *Greenway* and *Stapleton* numerous ore mines and limestone quarries have been opened on both sides of the river.

33. At *Lynchburg* the river has cut the beds (1 a. and b.) nearly at right angles, so as to expose a well-defined waving arch on the cliff opposite the city. For about 20 miles above the city the road continues on the gneisses, granites and slates of Archæan age.

34. At about a mile below *Rope Ferry* is the margin of a belt of alternating conglomerates, sandstones and slates about two miles wide, which were formerly classed as Huronian by Rogers and others. This belt flanks the southeast slope of the Blue Ridge, and is cut by the river so as to give fine exposures of its beds both above and below the railway bridge. The discovery we recently made of *scolithus* borings of the kind characteristic of Cambrian (Potsdam) sandstones in its beds, determines its age to be Cambrian. The "Snowdon Slate Quarries" are in this Cambrian belt three miles towards the northeast.

35. At *Balcony Falls*, between one and two miles below the station, the river has cut obliquely through the core of the main Blue Ridge and exposed a fine section of Archæan rocks. These have been formerly spanned by the Cambrian beds, the upper portions of which were doubtless ruptured at the time of the upheaval and swept away. At this point occurs the finest natural section of the whole Cambrian series to be found anywhere in Virginia. The alternations of conglomerates, shales and sandstones present an aggregate thickness of about 1,200 ft. The uppermost sandstone, about 350 ft. thick, is the typical Potsdam, and abounds in borings of *scolithus linearis*, thousands of which may be seen in the broken rocks at the junction of the Lexington branch, 150 yards above the station house. Here the road enters the Great Silurian Valley.

36. *Glenwood* is the station for stage line to Natural Bridge. (See Note 16.) The road here passes through a depression in the Sallings Mountain, an anticlinal ridge of primordial strata, 2 a. b. The *Natural Bridge*, three miles from this station by stage line, is in Lower Silurian limestone; the abutments in Quebec (3 b.); the arch and the adjacent hills in Chazy (3 c.) This great natural curiosity has been supposed by some observers to be the remnant of a natural tunnel, and by others the remains of an extensive cave, the top of which has all fallen in and been washed away except the narrow arch that now spans the chasm. Our belief is that it has resulted from a vertical fissure in the beds of limestone, which, by its opening, failed to rupture the portion of the uppermost beds that now forms the arch, but simply dragged them a few yards toward the west and left them stretched across the deep chasm, which has been subsequently enlarged by erosion. The entire absence of stalactites and stalagmites along the faces of the cañon militates strongly against the cave theory, while the secondary fissures still to be seen just above the bridge, together with the general

Richmond & Alleghany Railroad.—			Richmond & Alleghany R. R.—Con.		
No.	Continued.	Alt.	No.	Henrico R. R. Branch.	Alt.
196	Buchanan. ⁸⁸	8 b. L. Silurian. 887	0	Lorraine.	17. Jurassic Coal. 143
200	Jackson.	" 845	7	Henrico. ⁴⁸	{ 17. Jurassic Coal. (Coal mine.)
203	Glen Allen.	" 855	11	Hungary.	{ Archæan, near margin Tertiary. 814
205	Saltpetre Cave.	8 b. c. " 892			
208	Salisbury.	{ 8 b. c. L. Silurian. (Iron Furnace). ⁸⁹⁴			
212	Eagle Rock. ⁸⁹	4 a., 4 b. Trenton. 926			
216	Gala Water.	10 a. Devonian. 956			
.....	Ore Siding.	" "			
.....	Price's Bluff. ⁴⁰	Arch of 7 and 8.			
.....	Hadons.	10 a. b. Devonian.			
221	Baldwin.	" 970			
224	Wilton.	{ 10 a. b. Devonian. (Princess Fur.). ⁹⁹			
226	Lick Run.	10 a. b. Devonian.			
228	Iron Gate.	" "			
280	Clifton Forge ⁴¹	" 1083			
Lexington Branch.*					
0	Balcony Falls.	(See above.) 701			
5	Miller.	2 b., 3a. Nr. Margin 725			
10	Loch Laird. ⁴²	3 a., 3 b. L. Silurian. 784			
12	Green Forest. ⁴³	3 b. L. Silurian.			
16	South River.	3 b., 3 c. L. Silurian 850			
19	E. Lexington, jun. of Valley Ry.	4 a. Trenton. 910			
20	Lexington. ⁴⁴	" 1000			
			Ms. ** Shenandoah Valley Railway.* Alt.		
			0	Hagerst'n, Md. ⁴⁷	{ 4 a. Trenton, dip S. E. 566
			6	St. James.	" "
			9	Grimes.	3c., 4 a. Nr. Margin 822
			14	Antietam.	3 b. Siluro-Cambrian.
			17	Shep'n, Va. ⁴⁸	" "
			23	Shenandoah Jun.	3 b. c. " "
			29	Charlestown.	" "
			34	Ripon.	" "
			37	Fairfield.	" 522
			40	Berryville.	" 571
			47	Boyce.	" 575
			50	White Post.	" 610
			54	Ashby.	" 600
			57	Cedarville.	" 569
			60	Riverton. ⁴⁹	" 497
			62	Front Royal.	{ 2 b. Cambrian and 3 a. Calcif. 495
			67	Manor.	{ 3 b. c. Sil.-Camb.dip changes to N.W. 497
			73	Bentonville.	" 782

* By Professors J. L. and H. D. Campbell, except those notes marked "M," which are by Dr. A. S. McCreath, Chemist of the Second Geological Survey of Pennsylvania.

appearance of the place seem to favor the view here proposed. On the opposite side of the river are the Glenwood Iron Mines of Judge Anderson.

37. *Indian Rock.* Trenton limestone, gray coralline, quarried largely here for lime.

38. Purgatory Mountain terminates abruptly near Buchanan. It is a somewhat isolated outlier of North Mountain. Its base is Trenton limestone (4 a.), its main mass Utica and Hudson shales (4 b. and 4 c.), while its cap is Medina (5 a.); and in a synclinal trough held in a position where its top is double, it carries fine beds of limonite and red shale ores.

39. From *Buchanan* to *Eagle Rock* the limestones of 3 b. and 3 c. are exposed to view in several cuts, and at Eagle Rock they disappear beneath the groups of Trenton (4), of Medina (5), Salina? (6), Lower Helderberg (7), Oriskany (8), Marcellus, etc. (Devonian slates, 10 a. and 10 b.). The mountain at this pass is a prolongation of North Mountain, and has its higher members partially inverted, a feature very characteristic of this range throughout the greater portion of Virginia. The road here passes into a synclinal valley with Helderberg (7) and Oriskany (8) for its bottom, and most of its surface covered with Devonian slates. 10 a. b.

40. *Price's Bluff* is an anticlinal arch of 7 and 8, and furnishes good limestone and ore of iron.

41. *Clifton Forge* is a point of great interest to geologists. (See Rogers Note 13.)

42. *Loch Laird*. A small bed (or dike) of trap between two beds of calcareous shale (3 a.) may be seen 100 yards above the Shenandoah Valley Railway junction.

43. *Green Forest* is the station for the extensive Buena Vista Iron Mines, in the primordial (2 b.) shales at the northwestern base of the Blue Ridge.

44. For *Lexington* and its surroundings, see note No. 74.

45. *Henrico Coal Company's station for shipping coal and coke.*

46. This road, throughout its whole length of 240 miles, runs on the Siluro-Cambrian and the Cambrian formations, chiefly on the former.

47. *Hagerstown* stands on what seems to be the eastern portion of a closed and inverted syncline of Trenton age; the axis in the shales farther west. The Trenton limestones crop out near both of the depots, and are quarried for local building purposes. The road continues on this formation for several miles, but soon after passing Grimes it runs obliquely across the margin to 3 b. c.

48. At *Shepherdstown* are extensive exposures of 3 b. on the margins of the Potomac. Hydraulic limestone has been extensively quarried here for the manufacture of cement.

49. Between *Riverton* and *Port Republic* the Massanutten range of mountains is conspicuous on the northwest side of the road. (See Rogers note 7). The Blue Ridge is seen from the train on the southeast at nearly all points along the whole line. Over a large portion of the route the country rocks are very much obscured by the local drift from the adjacent mountains. In the larger boulders from the Blue Ridge, the burrows of the *scholothus linearis* are abundant.

Shenandoah Valley Railroad— Continued.			Shenandoah Valley Railroad— Continued.		
Ma.		Alt.	Ma.		Alt.
76	Overall. ⁵⁰	{ 8 a. Near Sil.-Camb., dip ch. to N.W. ⁵⁵²	148	Lyndhurst.	{ Obscured by drift, etc. 1240
80	Rileyville.	3 a. Calcif. " 720	151	Lipcomb. ⁵⁶	" 1200
85	Kimball.	" 805	153	Stuart's Draft.	" 1200
89	Luray. ⁵¹	{ Sta. on 3 b. entrance to cave on 3 c. 822	160	Greenville.	{ 3 b. c. Sil.-Camb., drift high on hills. 1550
96	Marksville. ⁵²	2 b. Spur of Cam. 1060	163	Lofton..	" 1420
102	Ingham.	3 b. c. Sil.-Cambrian. 960	168	Vesuvius. ⁵⁷	3 a. Sil.-Camb. 1165
104	Grove Hill.	Much ob- scured by drift and alluv. " 955	173	Marlbrook.	{ Bed of Tufa., cut by railroad.
107	Milnes. ⁵³		175	Midvale.	{ 3 a. b. Ore in 2 b., 3 a. b. Sil.-Cam. 1010
113	Elkton.		177	Irish Creek. ⁵⁸	" 930
128	Port Republic. ⁴⁹		180	Riverside.	" 800
129	Weyers Cave. ⁵⁴		186	Loch Laird. ⁵⁹	3 b. Sil.-Camb. 790
182	Patterson.	{ 3 a. b. Sil.-Cambrian cave in 3 b. c. 1125	189	Thompson. ⁶⁰	
187	Crimora. ⁵⁵	" 1185			
144	Waynesboro Jun.	" 1242			
		Margin of 2 b., 3 a. 1298			

50. *Overall.* Half a mile east of Overall station, Umber deposit, which has been partially developed. (M.)

51. *At Luray,* the station, the junction, and the greater part of the village, appear to rest upon the ledges of 3 b., Quebec (Levis), dipping 20° to 30° northwest, and passing beneath a ridge of 3 c. (Chazy), in which is the entrance to the caverns; and most probably the higher chambers are in the same formation, while the lower ones are either within or rest upon beds of 3 b. Everywhere in the great valley of Virginia the limestones of the Quebec, as a rule, are much more ferruginous than those of the Chazy, and consequently produce darker and more fertile soils. The Quebec also carries several thick beds of shale, while the Chazy is characterized in many places by beds of chert that contain characteristic fossils. The lithological peculiarities of these two formations, especially those which determine differences of soils, are well defined at Luray. (See note 75.)

52. *Marksville.* Considerable deposits of light brown ochre worked here by Oxford Ochre Company.

53. *Milnes.* About five miles south southeast of Milnes there is a fine exhibition of the Potsdam ores (in the slates above the Potsdam sandstone), the principal development being on Fox Mountain, a low flat crested ridge, a foot hill of the Blue Ridge. The present working face is 85x300 ft., and the daily output is over 100 tons, shipped over the branch road to the Shenandoah Iron Co.'s furnace, near Milnes. (M.)

54. *Weyers Cave* has the same geological relations as the Luray Cave, except that it is nearer the margin of the Trenton trough, which carries the Massanutten, and here extends to the southwest beyond the termination of the mountain range.

55. *Vesuvius.* The *Rockbridge* tin mines are in the Archæan core of the Blue Ridge, and may be reached by ordinary road, from either Vesuvius or Irish Creek Station.

56. *Crimora.* Two miles east from Crimora there is a large valuable deposit of Manganese ore, chiefly pyrolusite. The ore is very rich, and is now being mined in quantity for shipment to England and to Pittsburg, Pa., at the latter place for use in the production of a remarkably high grade of ferro manganese. (M.)

56. *Sherando.* Near Sherando (Lipcomb Station), deposits of China Clay and Fire clay are being worked. (M.)

57. *Vesuvius.* Eight miles southeast of Vesuvius Station, and on a bank of Irish Creek, there is quite an interesting exhibition of tin ore. The ore is Cassiterite; and at one point on the Cash property the ore showed remarkably rich, at times being almost pure Cassiterite, and some of the specimens showing one to one and a half inches in thickness of the pure ore. (See page 134 McCreath's Mineral Wealth of Virginia). Occasionally the tin ore has associated with it the mineral *Mispickel*, carrying more or less silver and gold. On the Vesuvius furnace property, and two and a half miles from the railroad, occurs a bed of brown hematite ore, ten feet wide, between nearly vertical walls of Potsdam sandstones. (M.)

58. Near *Irish Creek* a remarkable deposit of Dufrenite (Hydrated Ferric Phosphate), nearly a foot thick, of nodular and radiating structure, was found several years ago in the Potsdam shales, resting on a heavy bed of limonite ore. (See American Journal of Science, July 1881, pp. 65, etc.)

59. At *Loch Laird*, about sixty yards northeast of the crossing of the Richmond & Alleghany Railway, a *trap dike* about six feet thick may be seen thrust up between two beds of calc.-shale of 3 a.

59. *Loch Laird.* On the Buena Vista property there is a fine exhibition of the Potsdam ores (in the slates overlying the Potsdam), showing perhaps the finest development of these ores in the Shenandoah Valley. On the same property where Marl Branch crosses the Lexington Turnpike, there is exposed a bed of so called Marl, fully 40 ft. thick. It yields over 95 per cent. carbonate of lime. (M.)

60. At *Thompson* is an old cement quarry.

61. *Arcadia.* Near Buchanan, on the Arcadia furnace property, there are numerous openings made on the so-called specular ore of the Blue Ridge. The ore is a red hematite, more or less intimately mixed with fine grained quartz. Geologically it lies in the slates underlying the Potsdam sandstone. (M.)

62. *Itzha* is near the border of the extensive Cloverdale iron property; ore in 2 b. and 3 c.

Shenandoah Valley Railroad— Continued.			Baltimore & Ohio Railroad—Con. Harper's Ferry and Valley Branch.		
Ms.		Alt.	Ms.		Alt.
191	Buffalo Forge.	3 b. Sil.-Camb. 755	27	Stephenson's.	{ 4 a., 3 c. Siluro-Cam., and Cam. 499
199	Natur'l Br. 154 36	{ Station 3 a. b., Bridge 3 b. c.	32	Winchester.	{ The road runs 717
209	Arcadia. ⁶¹	2 b. nr. 3 a. Camb. 796	36	Kernstown.	{ close to bound-744
215	Buchanan.	3 b. c. Sil.-Camb. 837	39	Newtown.	{ ary of Cam., 3 c., 770
220	Lithia. ⁶²	{ " 968	42	Vaocluse. ⁷	{ and Sil.-Cam., 4
225	Houston. ⁶³	{ 3 a. " 1348	44	Middletown.	{ a., of belt lying 700
228	Troutville.	{ Ore of 2 b. near. 1125	46	Cedar Creek.	{ east, composed 695
233	Cloverdale. ⁶⁴	{ See note. 961	50	Capon Road.	{ largely of 4 c. 740
237	Tinker Creek.	{ 3 b. c. Sil.-Camb., nr. Trenton 4 a. 907	51	Strasburg Junc.	{ 4 a. b., Sil.-Camb., on switch track. 702
240	Roanoke.		55	Tom's Brook.	{ 3 b. c. Cambrian. 745
Norfolk & Western Railroad.			57	Maurertown.	{ " 788
283	Central. ⁶⁵		61	Woodstock.	{ " 820
298	Pulaski. ⁶⁶		66	Edinburg. ⁶⁷	{ " 845
Baltimore & Ohio Railroad. Harper's Ferry and Valley Branch. *			74	Mount Jackson.	{ 3 c., 4 a. Camb., and Sil.-Cambrian. 916
0	Harper's Ferry.	{ 2 b., 3 a. Altered Cambrian (b) or Archæan B, followed west by Cambrian. 277	81	New Market.	{ " 971
1	Shenandoah	{ 3 a. b. Cambrian. 339	88	Broadway. ⁶⁸	{ " 1088
6	Halltown.	{ 3 b. c. " 513	94	Linville.	{ 4 a. Trenton. 1242
10	Charlestown.	{ " 547	100	Harrisonburg. ⁸	{ 4 a. and 3 c. 1340
14	Cameron.	{ 4 a. b. Sil.-Camb. 495	105	Pleasant Valley.	{ 3 b. c. 1245
23	Wadesville.		106	Mt. Crawford	{ 3 b. c. 1172
			112	Weyers Cave. ⁵⁴	{ 3 b. c. nr. 4 a. S. E. 1155
			115	Mt. Sidney.	{ 4 a. near 3 c. 1257
			117	Fort Defiance.	{ 4 a. nr. 3 c. Graptolites in Tr. sha. 1275

* From 88 Broadway, South, by Profs. J. L. and H. D. Campbell; north of that by Prof. W. B. Rogers.

63. *Houston.* Near Houston Station are the Houston Mines of the Crozer Steel and Iron Co., extensively worked to supply their furnace at Roanoke. Rich Manganese ore is also mined here and shipped to Johnstown and Pittsburg. (M.)

64. Between *Cloverdale* and *Tinker Creek* the road skirts the northwest base of a Trenton ridge, capped with 5 a. b. sandstones. It is known locally as Mill's mountain; really an outlier of Tinker Mt.

65. The New River Division of the Norfolk & Western starts from *Central*, and has its present terminus at Pocahontas, where it strikes the great Flat Top coal field. It passes through a very interesting geological field. At Ripplemead Station there is a promising deposit of Magnetic Iron ore, in the No. 3 Lower Silurian Limestone opened up on the bank of New River. Some 5,000 tones of 63 per cent. ore have been taken out. (M.)

66. The "*Cripple Creek*" extension of the Norfolk & Western Railroad (now being built) starts from *Pulaski*, and will open up the Cripple Creek region (see note 21 on Virginia), with its vast stores of brown hematite ores in 3 b. and c. (and 2 b.), perhaps the finest and richest, and most uniform quality of (3 b. c., Lower Silurian) brown hematite ores in the United States. It will also bring within railroad communication (for the railroad will pass close to it) the 100 year old lead mine at Austinville, and the Bertha Zinc mine near New River, showing rich Zinc ore (Silicate and Carbonate of Zinc) almost free from lead, and now used at the Bertha Zinc Works, at Pulaski (Martins). Near Blue Ridge, and also near Roanoke (about two and a half miles south of it), important and seemingly very large deposits of Potsdam ores are now being mined at the former point, by the Crozer Iron and Steel Company, of Roanoke, and at the latter by Roser Iron Company.

From eight to ten miles south southeast of Bristol there are interesting deposits of hematite ore in the No. 11 limestones. These were opened, many years ago, to supply stock for the local charcoal furnaces, but the ores were found too refractory for economical use in such furnaces, and the workings were abandoned. The ore is a dense and fine grained hematite, and shows 64 to 66 per cent. iron and .020 and .030 of phosphorus. (M.)

67. *Edinburg* is the depot for the Liberty and Columbia furnaces, a few miles northwest, in the North Mountain range—good geological field.

68. *Broadway* is a good starting point for studying geology, etc., of Brock's Gap, an interesting region in North Mountain range.

69. *Staunton*, a flourishing little city at the junction of the valley railroad with the Chesapeake & Ohio, is situated on a number of somewhat distinct hills, and surrounded by others of still greater height. These are composed chiefly of Quebec (3 b.) magnesian limestones at their bases, especially on the northwest flanks, and Chazy limestones of lighter color above, with interbedded cherty masses, the fragments of which are seen strewn over the surfaces in great profusion. Several species of gastropod and cephalopod shells have been found fossil in these chert beds. The northeastern margin of the city rests on Trenton, 4 a., adjoining 4 c.; but the line of contact of these formations sweeps around the southeast and south flanks of two very conspicuous hills, known as "Betsy Bell" and "Mary Gray," and appears again on the valley road near Folly Mills Station, and continues near the line of road for several miles. (See Note 75 as to the Quebec group.)

Baltimore & Ohio Railroad—Con. Ma. Harper's Ferry and Valley Branch. Alt.			Baltimore & Ohio Railroad—Con. Ma. Harper's Ferry and Valley Branch. Alt.		
119	Verona.	4 a. Tr.—Cal. shales ¹³¹⁰	144	Raphine. ⁷¹	{ 3 b. c. Iron Ore in 8 c. 1335
126	Staunton. ⁶⁹	{ 4 a. at N. E. corner, 3 c. Chief Rocks, 3 b. west margin of city. 1355	149	Fairfield. ⁷²	{ 3 b. c. Iron Ore in 3 c., Houston's. ¹⁷⁰⁰ 1434
131	Folly Mills.	{ 4 a. near junc. with 3 c. 1490	154	Timber Ridge. ⁷³	{ 3 c. 4 a. Trenton lime- stone forms high river cliffs. Drift on hills. ⁹¹⁰
133	Mint Spring.	{ " 1553	160	{ B. & A. Junc., E. Lexington.	{ 4 a. b. on south, 3 c. west of town. 1000
138	Greenville. ⁷⁰	{ 3 b. c. Iron Ores in Cambrian of Blue Ridge, S. E. 1600	162	Lexington. ⁷⁴	

70. Near *Greenville* the Quebec (3 b.) limestones, producing ferruginous clay soils, crop out in the cuts for a mile northeast of the town, and along the banks of the adjacent stream both above and below the crossing; but the Chazy beds form the country rock of the town and region between it and *Raphine* Station. The Primordial (Cambrian) ridges of the Blue Ridge range extend much farther into the Great Valley opposite *Greenville*, than they do at any other point seen from the line of this road, and carry some productive beds of limonite ore.

71. About 2½ miles northwest of *Raphine* Station are very extensive beds of limonite ores on the lands of Samuel Carson, Esq., and Messrs. Gibbs & Rawlings. The beds of ore have been partially opened, and, where seen in place, appear to occupy about the same relative position among the Chazy (3 c.) limestones as the chert beds found in such abundance in other parts of the same formation. The Vesuvius Iron Mines are in 2 b., about four or five miles southeast of this station. The tin mines, now in process of development, are in the Archæan core of the Blue Ridge, about 12 miles southeast by turnpike.

72. At *Fairfield* the road crosses to the west side of *Timber Ridge*, and on the northwest margin of the valley, the elevated outliers of the North Mountain range—the Jump, the Hogback and House Mountains—become conspicuous features of a striking landscape.

73. From *Timber Ridge* Station a line of conveyances extends to *Rockbridge Baths*, a pleasant summer resort. The thermal water of these baths issues from the Quebec (3 b.) limestones near a fissure or fault where the beds of 4 a. Trenton have dropped down to the level of 3 b., and apparently dip beneath the latter, as may be seen at points northeast and southwest beyond the accumulations of river drift, which is found on hills here more than 100 feet above the bed of the river. About two miles northwest of the baths is the entrance to the famous "Goshen Pass," the deep cañon through which *North River* finds its way to the Great Valley. This cañon gives a complete section of the whole North Mountain range from 4 a. Trenton up to Devonian shales, 10 a. b. Fossils are abundant here. For sketch and geological section, see *Am. Jour. of Sci.*, Vol. XVIII., 1879, p. 119.

74. About one mile southwest of *Timber Ridge* Station the railway passes abruptly from the Chazy (3 c.) to the Trenton (4 a.), entering the irregular synclinal trough in which *Lexington* is situated. In the town, along the cliffs of the adjacent north branch of *James River*, and over about six miles of area towards the northeast and four miles southeast, the Trenton limestones (4 a.) are the country rocks; but in the Poplar Hills toward the southwest and south, the Utica shales, with very fossiliferous thin beds of limestone, become conspicuous. The Brushy Hills, west of the town, are composed of Chazy limestones and cherts (3 c.), as regards their southeastern slopes, while the northwestern slopes present exposures of 3 b. dipping beneath the hills. As far as measurements can be made here 3 c. is about 300 feet, and 3 b. about 450 feet thick. Along the eastern base of Brushy Hills the outcrop of the lower Trenton limestone, 4 a., is apparently an ancient coral-reef, now a very compact, pure coral limestone, quite largely quarried for local building purposes, and for the manufacture of lime. This coralline bed contains shells as well as coral. It varies from 100 to 150 feet in thickness.

The House Mountain (or rather pair of mountains), about six miles west northwest from *Lexington*, is one of the most striking features of the grand scenery in this portion of the Great Valley. This isolated mountain group rests upon Trenton limestone which crops out around the base. Then in nearly horizontal strata other formations, 4 b., as shales and shaly limestones, 4 c., as purplish, ferruginous shales and shaly sandstones, and above all a cap of Medina sandstones, 5 a.; the whole rising 2,000 feet above the limestone valley below. *Lexington* is a good point of departure for the geological study of either the Blue Ridge range on the S. E. or the North Mountain range on the N. W.

Washington and *Lee University* and the V. M. Institute, both located here, have good mineral and geological cabinets. For fuller details, and geological section across the Great Valley near *Lexington*, see *Am. Jour. of Sci.*, Vol. XVIII., 1879, p. 16.

75. *Quebec Group*. Dr. A. R. C. Selwyn, the successor of Sir Wm. Logan, as Director of the Geological Survey of Canada, does not recognize the Quebec as a geological formation, and in Professor J. D. Dana's table, as given in this guide, it is omitted, being considered as merged in the *Calceiferous*. Professor Campbell, of Virginia, is not prepared to adopt this view as suitable for that State. He reports that throughout the Great Valley of Virginia, 350 miles in length, with continuous ledges of limestone, there exists what is known as the Canadian group, consisting of three tolerably well defined sub-groups of limestones, with extensive beds of interstratified shales and calcareous sandstones in the lowest 3 a. *Calceiferous*; very regular stratified beds of dolomitic limestones more or less ferruginous and producing rich soils in the next higher 3 b. *Levis*; and, in the last, some beds of pure limestone, with a stratum of brown sandstone in the lower portion, abounding in molluscan fossils, not well preserved, but doubtless 3 c. *Chazy*; and still higher, near the Trenton, beds of chert abounding in cephalopods and gastropods of undoubted 3 c. *Chazy* age. He, therefore, prefers to retain the three divisions, at least until additional palæontological evidence settles the question at issue.

North Carolina.¹

LIST OF GEOLOGICAL FORMATIONS IN NORTH CAROLINA.

20. Quaternary.	1. Archæan.	1 b. Huronian.
19. Tertiary.	Igneous.	1 a. Laurentian.
18. Cretaceous.		
16. Triassic.		

1. Revised and the notes added for the first edition by W. C. Kerr, State Geologist of North Carolina. Enlarged and revised for the second edition by Dr. H. M. Chance, of Philadelphia, geologist in charge of explorations of North Carolina coal fields.

Sketch of the Geology and Topography of North Carolina.

Derived from the State Geological Reports of Prof. W. C. Kerr.

North Carolina is the Mountain State of the Atlantic slope. As a general description, it may be said that the surface of this State is covered by but two of the great formations. The (1) Archæan, sub-divided into the (1 a.) Laurentian and (1 b.) Huronian, the lowest occupies the western and the (20) Quaternary the upper system covers the eastern portion, the oldest and the youngest, with a vast geological blank between them. Some of the railways run for long distances on a single formation. An irregular line drawn on the map of the State, in a northeast and southwest direction, through the City of Raleigh, will show the relative portions of the State covered by each. The (16) Triassic, the only one of the intermediate groups which appears, covers but a comparatively insignificant area in the middle region. It contains the coal beds of Deep River and of Dan River. The (18) Cretaceous and (19) Tertiary, underlie the (20) Quaternary, but they only appear on the surface in a few localities, of small area, on the river bluffs, and in water courses and ravines in the eastern division. The complete geological series of the State is as follows: (20) Quaternary, (19) Tertiary, (18) Cretaceous, (16) Triassic, (1) Huronian, (1 a.) Laurentian and Igneous.

Most of the metamorphic rocks of North Carolina belong to the (1 a.) *Laurentian* system, which prevails so extensively in Canada, Michigan, Wisconsin, Minnesota, etc. The prevalent species are Granite, Gneiss, Syenite and other Hornblendic rocks, Diorite and Crystalline limestone, and these contain graphite and much magnetic and specular iron ore, frequently in very large beds. This formation, besides iron, produces gold, silver, lead, copper, and other minerals. The (1 b.) *Huronian*, the *Taconic* of Emmon's report on this State, occupies several disconnected areas on the Great Smoky Mountain, at the Tennessee line and on the Blue Ridge, and another considerable area west of Raleigh, extending across the State with two smaller exposures. The rocks are quartzite and clay slates, light colored, drab, and greenish. With these exceptions, and the small area of (16) Triassic, all the remainder of the western part of the State is (1 a.) Laurentian.

The North Carolina Mountains. The great continental system of the Appalachian Mountains, which extends a thousand miles, from near the mouth of the St. Lawrence to the State of Georgia, reaches its greatest elevations and develops its grandest features in the western part of this State. The system is here represented by two great parallel chains, the Smoky Mountains and the Blue Ridge, with a net-work of heavy cross chains connecting them and numerous spurs thrown off to the east and south, some of them as high as the parent chain and some more than fifty miles long. There are also several other disconnected minor chains to the eastward, with the same general trend. These mountains extend across the State, and their entire length from their southwestern termination, the Blue Mountains in Georgia, to their northern, which is prolonged 50 miles into Virginia, is 275 miles, of which two-thirds, or about 5,000 square miles, lie within North Carolina.

The main or western chain, which more to the north borders the great valley in Virginia and is there called the Blue Ridge, gradually deviates towards the southwest. A new chain, detached on the east and curving a little more to the south, takes now the name of the Blue Ridge, and in this State attains gradually to 5,000 and 5,900 feet, composed of many fragments, scarcely connected into a continuous and regular chain. These groups are separated by long intervals of depression, in which are gaps but little above the interior valleys.

West of this, and separated from it by a valley, is the great western chain of mountains, named locally the Iron Mountain in the northern portion, and Unaka in the southern, the whole being known as the Smoky Mountains, and forming the line between Tennessee and North Carolina. This is much more continuous, more elevated and regular in its direction and height, and increases very uniformly from 5,000 to nearly 6,700 feet. The valley comprised between these two main chains, the Smoky Mountain and the Blue Ridge, is divided by transverse chains into many basins of great altitude. The height of these transverse chains is greater than that of the Blue Ridge, being from 5,000 to 6,000 feet and upwards, and the gaps that cross them are as high, and often higher, than those of the Blue Ridge. The whole chain of valleys extends for more than 180 miles, and from 20 to 50 miles wide, with a mean height of more than 2,000 feet, and portions of them 3,500 to 4,000 feet, this being the highest plateau of the same extent east of the Rocky Mountains. These are all valleys of erosion, and they, as well as the mountains and plateaus have, in Prof. Kerr's opinion, no anticlinal or synclinal origin, being in fact wholly independent of geological structure.

The mountains which reach 6,000 feet are more than fifty in number, and the loftiest peaks rise to 6,700 feet. Here, then, in all respects, is the culminating region of the vast Appalachian system. This mountain region, where the most striking natural objects in the State are to be seen, has not yet been penetrated by the railroads, except that the Western North Carolina R. R. crosses the mountains, connecting with the East Tennessee, Virginia & Georgia R. R.

Richmond & Danville Railroad.			Western North Carolina Railroad.		
Ms.		Alt.	Ms.		Alt.
0	Richmond, Va.		0	Salisbury.	1 a. Lauren. 106 m. ⁷⁶⁶
141	Danville, Va.	1 a. U. Lauren. 42 m. ⁴²⁰	25	Statesville. ⁴	" " 955
156	Ruffin, N. C.	" " 707	48	Newton.	" " 1070
165	Reidsville.	" " 828	58	Hickory. ⁴	" " 1140
181	Moorehead.	" " "	78	Morganton.	" " "
189	Greensboro.	1 a. L. Lauren. 6 m. ⁸⁴³	99	Marion.	" " 1435
204	High Point.	" " 948	114	Henry.	1 b. Huronian. 8 m.
211	Thomasville.	" " "	126	Black Mountain.	" " "
222	Lexington.	" " 776	139	Ashville Junc.	1 a. Laurentian.
238	Salisbury.	" " 760	142	Ashville.	" " "
261	Concord.	" " "	143	Ducktown Junc.	" " "
282	Charlotte.	" " 728	165	Marshall.	" " 1647
312	State Line.	" " "	182	Warm Springs.	2 a. Oc., Cg. & Sh. ¹³²⁵
Goldsboro Branch.			.....	Wolf Ck., Tenn.	E. T. V. & Ga. R. R.
0	Greensboro.	1 a. Lauren. 80 m. ⁸⁴³	190	Paint Rock.	
21	Company Shops.	" " "	Ducktown Branch.		
32	Mebanesville.	1 b. Huronian. 20 m. ⁶⁸⁷	0	Ashville.	1 a. Laurentian.
41	Hillsboro. ³	" " 839	30	Waynesville.	" " "
46	University.	" " "	Raleigh & Gaston Railroad.		
55	Durham.	16. Triassic. 22 m. ⁴⁰⁰	0	Portsmouth, Va.	1 a. Laurentian.
69	Morrisville. ³	" " 808	0	Weldon.	" " 71
73	Carey.	1 b. Huronian. 6 m. ⁴⁹⁵	12	Gaston.	" " 153
81	Raleigh.	" " 817	53	Henderson.	" " 505
96	Clayton.	" " 847	61	Kittrells.	" " 417
106	Neuse River.	20. Quatern. 24 m. ¹¹²	97	Raleigh.	" " 303
109	Selma.	" " "	Raleigh & Augusta Railroad.		
118	Princeton.	" " 160	0	Weldon.	
130	Goldsboro.	" " 102	97	Raleigh.	1 a. Lauren. 3 m. ³⁰³
Salem Branch.			107	Cary.	1 b. Huron. 10 m.
0	Greensboro.	1 a. Laurentian. 843	114	Appex.	16. Triassic. 20 m. ⁵⁰²
17	Kernesville.	" " 1016	140	Sanford.	{ 16. Triassic, and 20 Quater. 11 m. ³⁵³
28	Salem or Winston	" " 884	152	Cameron.	16. Tr., Huron. 13 m. ³⁰⁹
			174	Kyser.	20. Quat., princ'ly ²⁸⁶
			194	Hamlet.	" " 331

2. At Hillsboro depot a good exposure of typical North Carolina Huronian slate, hydromicaceous.

3. At Morrisville depot a dike of dolerite visible. One and a half miles east of station beds of very coarse incompact conglomerate, the bottom beds of the Triassic, and probably glacial.

4. From Statesville west in the numerous deep cuts are seen fine examples of the *frost* drift, characteristic of sub-glacial regions. Also from Hickory to Morgantown many sections of the purple paragonite schists, which are peculiar to this region.

There is very little exposure of solid rock, and that only on the tops of a few high mountains or an occasional cliff. The mountains are covered to their very summits with dense forests, but with a deep and strong soil which is, however, according to Dr. T. Sterry Hunt's description, very unlike the layers of clay and loam with which we in the North are familiar. The rocks themselves, he says, although of gneiss and mica slate, like that which prevails over so great a part of New England, have undergone a process of decay which has rendered them so soft that they may be readily cut by a spade, although retaining all the veins and layers which mark their original stratification. Without having been broken or ground up, these hard rocks have moldered into a soft clayey mass, forming a soil fifty feet and often much more in depth, which from its peculiar structure has a natural drainage, and possesses great fertility. North Carolina, evidently, never was subjected to the action of glaciers like the Northern States. Only the valleys of the streams are covered with alluvium, consisting of sand, gravel and clay, the debris of the rocks of the higher ridges and mountains.

The middle and eastern part of the State is a long slope, extending from the rugged mountain plateau to the Atlantic. Next, however, to the plateau is a *pedmont* or *middle* region of hill country, with an average elevation of about 1,000 feet. This is divided by its rivers into three regions, drained by the Broad, Catawaba and Yadkin rivers, the slope of the first being toward the south, and that of the others a little east of north. These drainage surfaces are separated by two, nearly parallel, easterly chains of mountains, the South and Bushy Mountains, and are from 2,000 to 4,000 feet high. There are other easterly spurs of the Blue Ridge of similar elevation. This middle division or hill

Cape Fear & Yadkin Valley Railroad.			Wilmington & Weldon, and Wilmington, Ms. Columbia & Augusta Railroad. Alt.		
Ma.		Alt.			
0 Fayetteville.	{ 20. Quaternary, 1 b.		0 Weldon. ⁵	20. Quaternary. ^{7, 8}	
	Huron. 38 m. 320		8 Halifax.	"	
37 Sandford.	{ 16. Triassic, 20.		37 Rocky Mount.	"	
	Quaternary. 353		78 Goldsboro.	"	102
44 Egypt. ⁵	" 262		92 Mount Olive.	"	
47 Gulf. ⁶	" 279		114 Magnolia.	"	
54 Richmond.	"		148 Rocky Point.	"	
58 Ore Hill.	1 b. Huronian. 496		162 Wilmington. ⁵	"	10
63 Siler.	"		162 Wilmington. ⁵	"	10
70 Staley.	"		191 Maxwell's.	"	
75 Liberty.	"		208 Whiteville.	"	
82 Julian.	"		227 Fair Bluff.	"	
90 Pleasant Garden.	"		..... S. C. Line. ⁹	"	
98 Greensboro.	1 a. Laurentian. 843				
Carolina Central Railroad.			Tarboro Branch.		
0 Wilmington	20. Quater. 117 m. 10		0 Rocky Mount.	20. Quaternary.	
68 Lumberton.	" 185		17 Tarboro.	"	
111 Hamlet.	" 331		..... Bethel.	"	
117 Rockingham.	{ 20. Quaternary, and		45 Williamston.	"	373
	1 b. Huronian. 210				
123 Pee Dee River. ⁷	1 b. Huronian. 6 miles.		Halifax & Scotland Neck Railroad.		
128 Lysleville.	1 a. Laurentian. 5 m.		0 Halifax.	20. Quaternary.	
135 Wadesboro.	16. Triassic. 19 miles.		20 Scotland Neck.	"	
163 Monroe.	1 b. Huron. 25 m. 586		Asheville & Spartansburg Railroad.		
187 Charlotte.	1 a. L. Laurentian. 725		0 Spartansb'g, S. C.	1 a. U. Laurentian.	
199 Catawba River.	"		..... Flat Rock.	"	505
..... Lincolnton.	" 866		49 Hendersonville.	"	
229 Shelby.	" 875				

5. *Egypt.* Old coal shaft, 460 feet deep.

6. *Gulf.* Bituminous coal beds 2 ft. and $3\frac{1}{2}$ ft.-4 ft. thick, worked on a small scale during the war. Not now worked. Much troubled by trap dykes.

7. On both sides of the Pee Dee River are high dikes of dolerite for more than a mile, and 2 miles east a very coarse porphyritic granite, as well as between Lilesville and Wadesboro.

8. *Wilmington & Weldon Railroad.* 162 miles; north and south. This road runs throughout its whole length from Wilmington to Weldon on the (20) Quaternary formation, with occasional small exposures of the Tertiary (19 a.) Eocene and (19 b.) Miocene and of the (18) Cretaceous in the banks of the streams.

9. *Dismal Swamp.* This road skirts around the *Great Dismal Swamp*.

country extends 200 miles from east to west, and 150 miles northeast and southwest, and comprises nearly one-half of the territory of the State. It rises in going west about four feet to the mile, and attains an elevation of 1,000 to 1,500 feet at the foot of the Blue Ridge. The channels of the large rivers, however, are cut 100 to 300 feet below the intervening divides.

Between the swamp country, along the coast, and the hilly region of the interior, is a belt of level, sandy, barren territory, extending from near the line of Virginia across the entire State, and from 30 to 80 miles wide, covered by the long leaved pine. Spirits of turpentine produced in this pine region is the most important branch of manufacturing in the State.

The eastern division of the State extends from the coast, about 100 miles, to the lower falls of the rivers, and constitutes nearly two-fifths of the State. This region is for the most part nearly level or very gently undulating, except along the rivers on the upper reaches of which are bluffs and small hills. Its slope seaward is between one and two feet to a mile and it is covered by the horizontal strata of the quaternary underlain by the tertiary. They consist of the noncompacted sands, clays, marls and gravels, coarser materials predominating westward, and becoming successively finer towards the coast.

The Coast of North Carolina is remarkable for the shallow sounds and bays that extend along the entire sea front nearly 300 miles, the largest of which are Pamlico and Albermarle Sounds, the former 75 miles long by 15 to 20 miles wide, and the latter 50 by 5 to 15 miles, with a depth of water from a few feet to 20 feet. There are also along the coast 3,000 to 4,000 square miles of swamp lands, of which the Great Dismal Swamp, on the line between this State and Virginia, is well known.

The foregoing description of North Carolina will serve to give a general idea of the geology of South Carolina, also where the same formations are found.

J. M.

Atlantic, Tennessee & Ohio Railroad.			Norfolk Southern Railroad.*		
Ms.		Alt.	Ms.		Alt.
0	Charlotte.	1 a. L. Laurentian. ⁷²⁵	0	Norfolk.	20. Quaternary.
47	Slatesville.	" ⁸⁵⁵	9	Prince Anne.	"
Cheraw & Wadesboro Railroad.			42	Camden C. H.	"
0	Wadesboro, N. C.	16. Triassic.	46	Elizabeth City.	"
7	Bennett's.	20. Quaternary.	62	Hertford.	"
10	Morven.	"	74	Edenton.	"
15	Cheraw, S. C.	"	Jamesville & Washington Railroad.		
Charlotte, Columbia & Augusta R. R.			0	Jamesville.	20. Quaternary.
0	Charlotte.	1 a. L. Laurentian. ⁷⁴⁷	29	Washington.	"
10	Pineville.	" ⁵⁷⁵	Midland North Carolina Railway.		
14	S. C. State Line.	"	0	Goldsboro.	20. Quaternary. ¹⁰²
44	Chester, S. C.	" ⁵⁴³	22	Smithfield.	"
Chester & Lenoir Railroad.			Milton & Sutherlin Railroad.		
0	Chester, S. C.	543	0	Sutherlin, Va.	1 a. U. Laurentian.
23	Yorkville.		9	Milton, N. C.	"
45	Gastonia, N. C.	1 a. U. Laurentian. ⁸³²	Oxford & Henderson Railroad.		
49	Dallas.	" ⁹⁴⁴	0	Henderson.	1 a. Laurentian. ⁵⁰⁵
63	Lincolnton.	1 b. Huronian. ⁸⁶⁶	13	Oxford.	16. Triassic.
79	Newton.	1 a. U. and L. Lau. ¹⁰⁷⁰			1 b. Huronian.
89	Hickory.	" ¹²²²			1 a. L. Laurentian.
109	Lenoir.	1 a. U. Laurentian ¹¹⁸⁶	Petersburg Railroad.		
Atlantic & North Carolina Railroad.			0	Petersburg, Va.	20. Quaternary.
0	Goldsboro.	{ 20. Quaternary with 18. Cretaceous and 19. Ter. in banks of the streams. ¹⁰²	10	Reams.	"
14	La Grange.		53	Pleasant Hill.	"
50	Newbern.		64	Weldon.	" ⁷²
85	Newport.	"	Seaboard & Roanoke Railroad.		
95	Moorhead.	"	0	Portsmouth, Va.	
Danville, Mocksville & Southwestern R. R.			70	Seaboard.	
0	Danville, Va.	16. Triassic.	78	Garys.	
8	Leaksville, N. C.	1 a. U. Laurentian.	80	Weldon.	20. Quaternary. ⁷²
E. Tennessee & W. North Carolina R. R.			University Railroad.		
0	Johnson City, T.		0	University.	1 b. Huronian.
26	Roan Mt., N. C.		11	Chapel Hill.	"
33	Cranberry.	1 b. Huronian.			
34	Mine.	" Iron Mines.			

South Carolina.¹

Ashley River Railroad.		Alt.	Augusta & Knoxville Railroad.		Alt.
Charleston. ⁹	{ Post Plioc. at depth, of 90 ft. Eocene 900 ft. Cretaceous. (H.)		0 Augusta, Ga.		
Northeastern R.R.			16 Woodlawn.	Gneiss. (L.)	
Asheville & Spartanburg Railroad.			20 Merriwether.	"	
Spartanburg.	{ 1 a. U. Laurentian (K.) Gneiss. 787		24 Clark's Hill.	"	
Air Line Junc.			29 Modoc.	Clay Slate. (L.)	
Hampton.	"		32 Parksville.	"	
Hamman.	Mica Slate. (L.)		38 Plum Branch.	Talc Slate. (L.)	
Campobello.	{ 1 a. U. Laurentian (K.) Gneiss.		43 McCormick. ³	"	
Hamdrums.			49 Troy.	"	
Tryon, N. C.	"		54 Bradley.	Dike of Dioritic por'y.	
Atlanta & Charlotte Air Line Railroad.			59 Verdery.	Talc slate.	
Atlanta, Ga.			67 Greenwood.	Mica, Slate and Dior.	
Fort Madison.	Hornblende slate. (L.)		Central Railroad of South Carolina.		
Harbins.	Gneiss. (L.)		0 Lanes.	19 c. Plio. Marls. (T.)	
Vestminster.	Mica slate. (L.) 919		4 Heinnesman's.	"	
Richland.	Hornblende slate. (L.)		8 Greeley's.	"	
Seneca.	Gneiss. (L.) 954		10 Mt. Hope.	"	
Geowee.	"		13 Forrestone.	"	
Central.	Mica slate. (L.)		19 Wilson.	19 a. Eocene Marls. (T.)	
Liberty.	Steatite. (L.)		22 Manning.	"	
Wastley's.	Gneiss. (L.)		26 Dudley.	"	
Aluda.	Mica slate. (L.)		28 Harbin's.	"	
Greenville.	Gneiss. (L.) 976		30 Durant.	"	
Waylor's.	{ Dike aphanitic por- phyry. (L.)		33 Lawrence.	"	
Freer's.			40 Sumter.	"	
Buncan's.	Mica slate. (L.)		Charleston & Savannah Railroad.		
Wellford.	Gneiss. (L.)		0 Charleston.	Post Pliocene. (S.)	
Air Forest.	"		7 Charleston Junc. ⁴	"	
L. Junction.	"		10 Dorchester.	"	
Spartanburg.	" 787		12 Drayton.	"	
Mount Zion.	Mica slate. (L.)		16 John's Island.	"	
Cowpens. ²	Gneiss. (L.)		19 Rantowles.	"	
Hicketty.	Mica. (L.)		25 Ravenal. ⁴	"	
Affney's.	Itacolumite. (L.)		35 Adams Run.	19 a. Eocene Marls. (T.)	
Black's.	Blue Lime s. (L.) 774		37 Jacksonboro.	Post Pli. Phosphate. ¹⁷	
Whitaker's.	Melaphyre Dike (L.) 907		42 Ashepoo.	19 a. Eocene Marls. (T.)	
Kings Mt., N. C. ²	942		46 Greenpond.	"	
			51 White Hall.	"	
			58 Saltkehatchie.	"	
			60 Yemassee.	Post Pliocene. 33	
			68 Coosa whatchie.	19 a. Eocene Marls. (T.)	

Prepared for this work by Mr. Harry Hammond, of Beech Island, South Carolina. The cities for the geology are designated as follows: H. stands for Prof. Francis Holmes; K. for W. K. of North Carolina; L. for Oscar M. Lieber; T. for M. Tuomey; S. for Charles N. Shepard. The great group of crystalline rocks which extends from New England to Alabama is Metamorphic in fossils, and hence of doubtful age. In the opinion of some geologists, instead of attempting to classify them, it is better to insert in this guide, as Mr. Hammond has done for South Carolina, the list of rock along the line of the railroad, e. g.: Gneiss, mica schists, granite, etc., which gives us positive knowledge.

Cowpens to King Mountain. Itacolumite, or Diamond rock, the prevailing rock, with seams of limestone, barytes, hematite, specular and argillaceous schist, with numerous gold and silver, and quarries of various rocks.

McCormick. Ores of gold manganese and copper abound.

Beds of Phosphate Rock.

Charleston & Savannah Railroad—			Cheraw & Chester Railroad.		
Ma.	Continued.	Alt.	Ma.		Alt.
77	Ridgeland.	19 a. Eocene Marls. (T.)	0	Chester.	{ Dike of Aphanitic
84	Terabee Switch.	"	6	Orr's.	Porphyry. (L.)
91	Hardeeville.	"	8	Knox.	Gneiss. (L.)
96	Savannah River.	"	10	McDaniels.	"
Charlotte, Columbia & Augusta R. R.			12	Richburg.	Mica Slate. (L.)
0	Charlotte, N. C.		15	Bascomville.	Talc "
17	Fort Mills.	Steatite. (L.)	18	Cedar Springs.	"
20	Catawba River.	Granite. (L.)	20	Fort Lawn.	{ Dike of Aphanitic
25	Rock Hill.	Gneiss. (L.)	22	River.	Porphyry. (L.)
31	Warren's.	{ Dike of Aph.	25	Waxhaw.	Talc Slate. (L.)
34	Smith's.	por'y (L.)	27	Miller's Crossing.	"
37	Lewis.	"	29	Lancaster.	Melaphyre Dike.
44	Chester.	"	Cheraw & Darlington Railroad.		
55	Blackstock's.	Known as Black Jack lands.	0	Florence.	{ 18. Cretaceous of the
58	Woodward's.	"	5	Palmetto.	secondary. (T.)
63	White Oak.	"	10	Darlington.	"
66	Adger's.	Gneiss.	18	Doves.	19 c. Plio. Marls. (T.)
71	Winnsboro.	"	27	Society Hill.	19 a. Eocene. (T.)
74	Robertson's.	"	34	Cash's.	"
77	Simpson's.	"	40	Cheraw.	"
82	Ridgeway.	Mica Slate.	Cheraw & Salisbury Railroad.		
90	Blythewood.	Clay Slate. (T.)	0	Cheraw.	{ 19 a. Eocene crosses
98	Sharps.	"	11	McFarlan's, N. C.	clay slate.
96	Killian's.	Eocene Buhrstone. (T.)	Chester & Lenoir Railroad.		
100	100-Mile Siding.	"	0	Chester.	{ Dike of Aphanitic
106	Columbia.	Granite. (T.)	8	Lowrysville.	Por'y. (L.)
108	W. C. & A. Junc.	"	14	McConnellsville.	Melaphyre Dike. (L.)
120	Lexington.	"	16	Guthriesville.	Mica Slate. (L.)
125	Barr's.	Eocene Buhrstone. (T.)	23	Yorkville.	Granite. (L.)
130	Keisler's.	"	33	Clover.	"
131	Gilbert Hollow,	"	37	Bowling Green.	"
133	Summit.	"	39	Crowder's C'k.	"
138	Leesville.	Granite. (T.)	Columbia & Greenville Railroad.		
140	Batesburg.	"	0	Columbia.	Granite. (T.)
149	Ridge Spring.	"	6	Frost's Mill.	Clay Slate. (T.)
153	Ward's T. O.	"	9	Swygert's Mill.	"
158	Johnson's T. O.	"	11	Montgomery's M.	"
165	Trenton.	"	13	Bookman's.	"
170	Miles Mills.	"	20	Wallaceville.	"
174	Vaocluse.	"			
178	Graniteville.	"			
179	Aiken Junction.	19 a. Eo. Buhrstone (T.)			
182	Langley.	"			
184	Bath.	"			
189	Dead Fall.	"			
191	Augusta, Ga.	185			

4. *Charleston Junction to Revanel.* Beds of phosphate rock. The phosphate rock of South Carolina, from which large quantities of valuable fertilizers are manufactured, contains 55 to 61 per cent. of phosphate of lime, and 5 to 10 per cent. of carbonate of lime, with small quantities of magnesia, sulphuric acid, etc. It is in the form of nodules, very rough, rounded and indented, and frequently perforated with irregular cavities of an olive, blueish, black, yellowish, brown, or grayish-white color, and from a few inches to several feet in diameter. The River Rock occurs as nodules, and sometimes as a continuous sheet 8 to 18 inches thick. It is profitably dredged for to depths of 20 feet, and a royalty of one dollar per ton is paid to the State for all taken from navigable waters. The land rock is found about the level of mean tide in layers 6 to 30 inches thick of loose nodules, and is profitably mined under 7 feet of earth. It is found in various places from Florida to North Carolina, has been raised in artesian wells from a depth of 300 feet, and brought up from sea bottoms several hundred miles from shore.—*Harry Hammond, in Hand-Book of South Carolina.*

Columbia & Greenville Railroad.			Georgetown & Lane's Railroad.		
Continued.			Alt.	Ms.	Alt.
ston.	Clay Slate. (T.)	259	0 Georgetown.	Post Pliocene. (T.)	
ake's.	"		18 Harper's.	{ 18. Cretaceous of secondary. (T.)	
maria.	{ Mica and Talc Slate. (T.)	330	26 Trio.	"	
osperity.	{ Dike of Feldspathic and Hornblende Rocks.		36 Lane's.	Pliocene Marls. (T.)	
owbery.	"	502	Northeastern Railroad.		
lena.	Granite. (T.)	532	0 Charleston.	Post Pliocene.	16
lver Street.	Gneiss. (T.)		2 Magnolia.	"	
luda Old Town	"		6 C. & S. Junction.	"	
appell's.	"		8 8-Mile Turnout.	{ Post Pliocene, Phosphate Rock. (S.)	
son's.	{ Dioritic aphanitic felspathic porphyry with epidiotite. (L.)	570	14 Otranto.	"	
nety-Six.	"		18 Mount Holly.	"	
ow Market.	Gneiss. (L.)		23 Strawberry.	"	
eenwood.	Mica Slate. (L.)	671	25 Oakley.	"	
dge's.	Gneiss. (L.)	714	30 Monck's Corners.	"	
nnald's.	{ Crosses Sandstone, Hornstone and Quartzic Schists. Gneiss (L.)	760	35 Macbeths.	{ 19 a. Eocene, Ashley & Cooper Marls. (T.)	
onea Path.	"	810	38 Bonneaus.	"	
lton.	"	896	45 St. Stephens.	{ 19 a. Eocene Santee Marls. (T.)	
illiamston.	"	840	49 Santee.	"	
lger.	"		51 Gourdin.	"	
edmont.	"		54 Cane's.	19 c. Pliocene Mar. (T.)	
eenville.	"	989	59 Salter's.	"	
Abbeville Branch.			64 Kingstree.	{ 18. Cretaceous of secondary. (T.)	
edges.	Gneiss (L.)	714	75 Cade's.	"	
arraugh's.	"		79 Graham.	"	
beville.	Dioritic Por'y (L.)	535	82 Scranton.	"	
Blue Ridge Railroad.			86 Coward's.	"	
lton.	Gneiss. (L.)	896	92 Effingham.	"	
nderson.	"	764	95 Willoughby.	"	
rds Crossing.	"		102 Florence.	"	
ndleton Factory	"		Port Royal & Augusta Railroad.		
ndleton.	"		0 Augusta, Ga.		186
lams Crossing.	Mica Slate. (L.)		6 Beech Island.	{ 19 a. Eocene Buhrstone. (T.)	
neca.	Gneiss. (L.)		10 Brown's Hill.	"	
uford's Mill.	"		15 Jackson.	"	
alhalla.	{ Gneiss and Hornblende Slate. (L.)	985	22 Ellenton.	{ 19 a. Eocene Santee Marls. (T.)	140
Laurens Railroad.			28 Robbins.	"	
lena.	Granite. (T.)		32 Hattievile.	"	
lapa.	Gneiss. (T.)		37 Millett.	"	
ldville.	"		44 Beldoc.	"	
inton.	"		49 Appleton.	"	
rk's.	"		53 Allendale.	"	192
urens.	"		58 Campbellton.	"	
			62 Brunson.	"	
			68 Hampton.	"	
			70 Varnville.	"	
			72 Almeda.	"	

Port Royal & Augusta Railroad.			Branchville to Columbia.		
Ms.	Continued.	Alt.	Ms.		Alt.
75	McNeils.	{ 19 a. Eocene. Santee Marls. (T.)	62	Branchville.	{ 19 a. Eocene, Santee Marls. (T.)
81	Early Branch.	{ 19 a. Eocene. Cooper & Ashly Marls. (T.)	66	Sixty-Six.	"
87	Yemassee.	19 c. Post Pliocene. 25	70	Rowesville.	"
92	Tomotly.	"	75	Felder.	"
99	Seabrook.	"	79	Orangeburg.	" 265
108	Island Tank.	{ 19 c. Post Pliocene Marls, Phos. Rock.	81	Stilton's.	"
108	Beaufort.	" " 20	85	Jameson's.	"
112	Port Royal.	" " 27	88	Riley's.	{ 19 a. Eocene Buhr- stone. (T.)
South Carolina Railroad.			92	St. Mathew's.	"
0	Charleston.	Post Pliocene. (T.) 18	95	Singleton's.	"
1	Magnolia.	"	99	Fort Motte.	"
4	West's.	"	102	Congaree.	"
7	Seven Mile.	{ Post Pliocene, Phos- phate Rock. (S.)	106	Kingville.	"
10	Ten Miles.	"	110	Gadsden.	"
12	Sineath's.	"	118	Hopkins.	"
15	Woodstock.	{ 19 a. Eocene, Ashley and Cooper Marl(T.)	124	Hampton.	"
17	Ladson's.	"	127	Taylor's.	"
22	Summerville.	" 65	129	Columbia Junc.	Granite.
26	Jadburg.	"	180	Columbia.	" 288
31	Ridgeville.	{ 19 a. Eocene, Santee Marls. (T.)	Kingsville to Camden.		
37	Rosses.	"	106	Kingsville.	19 a. Eo. Buhrstone(T.)
38	Whartons's.	"	110	Wateree.	"
41	Forty-One.	"	115	Middleton.	"
44	Birds.	"	118	Camden Junc	"
47	George's.	"	121	Dixie.	"
52	Reeve's.	"	125	Claremont.	"
58	Fifty-Eight.	"	131	Sanders.	"
62	Branchville.	" 140	135	Boykin's.	"
67	Edisto.	"	138	Stockton.	"
72	Midway.	"	144	Camden.	"
75	Bamberg.	" Buhrstone. (T.)	Spartanburg, Union & Columbia Railroad.		
81	Grahams.	"	1	Alston.	Clay Slate. (T.) 269
86	Lee's.	"	2	Parr's.	Mica "
89	Blackville.	"	8	Dawkin's.	"
93	Reynold's.	"	13	Blairs.	Gneiss.
96	Elko.	"	19	Shelton.	Granite. (T.)
99	Williston.	"	26	Fish Dam.	Gneiss. (L.)
102	White Pond.	"	31	Santuc.	Granite. (L.)
107	Windsor.	"	39	Union.	" 579
115	Montmorence.	"	49	Jonesville.	Mica Slate. (L.)
120	Aiken.	"	56	Pacolet.	"
126	Graniteville.	" Kaolin Clay(T.)	59	Rich Hill.	Gneiss. (L.)
128	Langley.	"	63	Glendale.	"
131	Bath.	"	68	Spartanburg.	" 787
132	Horse Creek.	"	Wilmington, Columbia & Augusta Railroad.		
136	Hamburg.	"	0	Columbia.	Granite. 281
138	Augusta, Ga.	"	6	Simms.	19 a. Eo. Buhrstone(T.)
			16	Congaree.	"
			22	Eastover.	"
			25	Acton.	"
			31	Camden Crossing	"

Wilmington, Columbia & Augusta Railroad—Continued.			Barnwell Railway.		
Ms.		Alt.	Ms.		Alt.
33	Wedgetield.	19 a. Eo Buhrstone. (T.)	0	Blackville.	19 a. Buhrstone of Eo.
37	Cane Savannah.	"	4	Ashleigh.	"
43	Sumter.	"	6	Woodward's Jun.	"
52	Maysville.	19 c. Plioc. Marl. (T.)	9	Barnwell C. H.	{ 19 a. Santee, or Cor- alline Marls of Eo.
57	Atkins.	"	Cape Fear & Yadkin Valley Railroad.		
61	Lynchburg.	"	0	Bennetsville.	19 a. Eocene.
65	Cartersville.	"	6	Tatum.	"
71	Timmersville.	{ 18. Cret. Marls of secondary. (T.)	9	McCall.	"
77	Ebenezer.	"	13	Hasty.	"
82	Florence.	"	15	Johns, N. C.	"
88	Mars Bluff.	"	Greenwood, Laurens & Spartanburg R. R.		
95	Pee Dee.	"	0	Greenwood.	Gneiss.
99	Laughlins.	19 c. Plioc. Marls. (T.)	7	Coronaco.	Granite.
108	Marion.	"	15	Waterloo.	Gneiss.
112	Mullins.	19 a. Eo. Buhrstone. (T.)	20	High Point.	Gneiss.
118	Nichols.	"	24	Maddens.	Trap Rock.
127	Fair Bluff, N. C.	"	28	Lauren's.	Gneiss.

Georgia.¹

GEOLOGICAL FORMATIONS OF GEORGIA.

The Metamorphic area of the State extends from a line crossing the State from Augusta to Columbus, extending by Milledgeville and Macon, and extending beyond the line of the State on the northeast. The lithological characteristics of the Metamorphic is that of the Archæan in general.

The *palæozoic* includes the counties of Dade, Walker, Chattooga, Catoosa, Whitfield, Floyd, Murny, Gordon, Barton and Polk, all in the northwest corner of the State.

The *Silurian* groups represented, beginning with the lowest, are the Potsdam sandstone, Knox Shale and Dolomite, Chazy, Trenton, Cincinnati, Medina, Clinton and Oriskany. The Devonian is represented by a black shale of from 10 to 50 feet in thickness. The Sub-Carboniferous by limestones and shales of 800 feet. The Coal Measures, confined mostly to the counties of Dade, Walker and Chattooga, cover an area of nearly 200 square miles, and contain several beds of coal.

Charleston & Savannah Railroad.			East Tennessee, Virginia & Georgia R. R. Macon & Brunswick Division.		
Ms.		Alt.	Ms.		Alt.
0 Savannah.	19 c. Tertiary.	32	0 Brunswick.	19 c. Tertiary.	14
24 Fleming.	"		40 Jesup.	"	100
39 Walthourville	"		70 Baxley.	"	210
53 Doctortown.	"		93 Lumber City.	19 a. Tertiary.	130
57 Jesup.	"	100	100 Town's.	"	135
86 Blackshear.	"		140 Dubois.	"	394
122 Homersville.	"		148 Cochran.	"	341
130 Dupont.	"		161 Buzzard Roost,	"	240
139 Stockton.	"		171 Bullard's.	"	205
157 Valdosta.	"		186 Macon.	Met. and Tertiary.	304
174 Quitman.	19 a. Tertiary.		148 Cochran.	19 a. Tertiary.	341
188 Boston.	"		159 Hawkinsville. ³	"	235
200 Thomasville.	"		Central Railroad of Georgia.		
214 Cairo.	"		0 Savannah.	19 c. Tertiary.	32
226 Climax.	"		50 Halcyondale. ²	19 a. "	110
236 Bainbridge.	"		62 Ogeechee.	"	106
200 Thomasville.	19 a. Tertiary.		79 Millen. ³	"	138
232 Camilla.	"		134 Tennille.	19 a. Tertiary.	
258 Albany. ²	"	232	154 Toombsboro.	"	342
130 Dupont.	19 c. Tertiary.		170 Gordon.	"	
151 Statensville.	"		192 Macon. ⁴	Met. and Tertiary.	334
163 Jasper, Fla.	"		79 Millen.	19 a. Tertiary.	138
179 Live Oak, Fla.	"		100 Waynesboro.	"	117
Brunswick & Albany Railroad.			132 Augusta. ⁴	Met. and Tertiary.	134
0 Brunswick.	19 c. Tertiary.	14	179 Gordon.	19 a. Tertiary.	240
13 Hazlehurst.	"	261	187 Milledgeville.	20. Ter. and Met.	310
24 Waynesville.	"		208 Eatonton.	Metamorphic.	
60 Waycross.	"	100	0 Macon. ⁴	Met. and Tertiary.	334
67 Waresboro.	"	117	25 Forsyth.	"	735
78 Milwood.	"	130	41 Barnesville.	"	875
93 Kirkland.	"		59 Griffin.	"	975
101 Willcoochee.	"	220	67 Fayette.	"	
151 Isabella.	19 a. Tertiary.	340	76 Lovejoy's.	"	905
171 Albany. ²	"	168	80 Jonesboro.	"	1045
			96 East Point.	"	1045
			103 Atlanta. ⁵	"	1050

1. Revised and the notes added for the first edition by Dr. George Little, State Geologist of Georgia; and for the second edition by A. R. McCutchen, of the Department of Agriculture of Georgia.

2. Buhrstone groups.

3. Northern limit of the open pine and wire grass section.

4. Located on the line of Metamorphic and Tertiary.

5. Strangers should visit the Geological Collection Room in Capitol Building.

Central Railroad of Georgia—Con. Southwestern Railroad.			Georgia Railroad. Continued.		
Ms.		Alt.	Ms.		Alt.
0	Macon. ⁴	Met. and Tertiary. ³³⁴	104	Madison.	Metamorphic. 681
8	Seago.	Tertiary. 362	130	Covington.	" 748
29	Fort Valley.	19 a. Tertiary. 530	141	Conyers.	" 894
49	Montezuma.	" "	147	Lithonia.	" 937
60	Andersonville. ⁶	" 396	156	Stone Mountain. ⁸	" 1033
71	Americus.	" 362	165	Decatur.	" 1050
83	Smithville.	" 334	171	Atlanta.	Asbestos, 3 miles. ¹⁰⁵⁰
96	Leesburg.	" "	0	Camak.	Metamorphic. 592
107	Albany. ²	19 a. Ter. Buhrstone ²³²	.....	Warrenton.	" 506
.....	Walker's.	" "	.....	Sparta.	" 567
.....	Ducker.	" "	.....	Milledgeville.	" 310
.....	Arlington.	" "			{ 3 miles Artope's quarry, Lyell's Eocene fossils. ³³⁴
29	Fort Valley.	19 a. Tertiary. 530	78	Macon.	
50	Butler.	20. "			
70	Geneva. ⁴	" "	57	Barnett.	Metamorphic. 647
75	Box Spring.	" "	75	Washington.	" "
78	Upatoi. ⁴	Metamorphic.	76	Union Point.	Metamorphic. 658
100	Columbus. ⁷	Met. and Creta. 262	... Lexington.	" "	770
29	Fort Valley.	19 a. Tertiary. 530			{ Metamorphic. 694 State University and Agricuilt College.
42	Perry.	" "	116	Athens.	
88	Smithville.	19 a. Tertiary. 334			
98	Dawson.	" 354			
118	Cuthbert.	" 448			
133	Hatchie Station.	18 c. Cretaceous.			
142	Georgetown.	" "			
144	Eufaula, Ala.	" 200			
157	White Oak, Ala.	" "			
165	Clayton, Ala.	" "			
120	Junction.	19 a. Tertiary.			
128	Coleman.	" 393			
132	Fort Gaines.	" 166			
	North and South Railroad.				
100	Columbus. ⁴	Met. and Creta. 262			
108	Cleghorn.	Metamorphic.			
120	Kingsboro.	" 612			
	Upson County Railroad.				
0	Macon. ⁴	Met. and Tertiary. ³³⁴			
43	Barnesville.	Metamorphic. 875			
51	The Rock.	" "			
59	Thomaston.	" "			
	Georgia Railroad.				
0	Augusta.	134			
38	Thomson.	Metamorphic. 517			
47	Camak.	" 592			
57	Barnett.	" 647			
65	Crawfordville.	" 603			
76	Union Point.	" 658			
84	Greensboro.	" 612			
	Atlanta & West Point Railroad.				
			0	Atlanta.	Metamorphic. 1050
			6	East Point.	" 1043
			18	Fairburn.	" 1034
			25	Palmetto.	" 1025
			40	Newman.	R. R. to Carrollton. ⁹⁵⁹
			52	Grantville.	{ Gold mine, 3 miles. Metamorphic. 869
			58	Hogansville.	" 721
			72	La Grange.	{ Metamorph. Asbes- tus and Chromic Iron, 7 miles. 742
			87	West Point.	{ Metamorph. Asbes- tus & Corundum ⁵⁸⁴
	Piedmont Air Line Railroad.				
			312	N. C. State Line.	Metamorphic.
			337	Gaffney's, S. C.	" "
			357	Spartanburg.	" 787
			387	Greenville.	" 976
			454	Toccoa City, Ga. ⁹	" "
			.....	Mt. Airy. ¹⁰	" 1587
			.....	Bellton.	" "
			481	Lula City.	{ Met. N. E. R. R. to Athens, 39 ms. 1834
			492	New Holl. Spr'gs.	Limestone & Tremolite
			494	Gainesville. ¹¹	{ 3 b. Metamorphic, flexible s. s. 1227

6. View of old Prison stockade and U. S. Cemetery east of railroad.
7. Fine falls, Lover's Leap and rapids, on Chattahoochee River.
8. Stone Mountain—a mass of granite—height, 1,686 feet.
9. Toccoa Falls, 2 miles, 185 feet. Tallulah Falls, 15 miles distant, nearly 400 feet high.
10. From this point a fine view of Yonah Mountain and the Blue Ridge chain. Clarkesville, 8 miles; Nacoochee Valley, 15 miles; Nacoochee gold mines, 23 miles.
27. Point of departure for Dahlonega gold mines and Porter's Springs.

Piedmont Air Line Railroad— Continued.			Alt.	Western & Atlantic Railroad— Continued.			Alt.
.....	Flowery Branch.	8 b. Metamorphic.		115	Ringgold. ¹⁵	Trenton.	788
.....	Buford.	"	1207	120	Graysville.	{ K. Shale and Lime quarry.	706
.....	Suwanee.	"	1027	125	Chickamauga.	"	685
.....	Duluth.	{ Metamorphic. Pine tree visible 4 ms. in center R. R. tk. ¹¹⁰⁷	1107	130	Boyce, Tenn.	"	694
527	Norcross.	Metamorphic.	1078	137	Chattanooga, Tenn.	{ 5 b. Clin. iron ores & 8 b. Calhoun, K. Sh. & K. Dol., Que.	684
540	7-Mile Track.	Met. Granite quarry.					
547	Atlanta. ⁵	"	1050				
Rome Railroad.				Northeastern Railroad of Georgia.			
0	Rome.	Knox Shale.	627	0	Athens.	Metamorphic.	694
20	Kingston.	"	710	12	Nicholson.	"	698
Cherokee Railroad.				18	Harmony Grove.	"	954
48	Cartersville. ¹²	Knox Shales.	760	26	Mayaville.	"	1001
.....	Rockmart.	Cal. and Potsdam.		39	Lula City.	"	1224
Selma, Rome & Dalton Railroad.				Savannah, Griffin & North Alabama R. R.			
0	Dalton.	Tren. & K. Dolomite	757	0	Macon.	Metamorphic.	324
6	Stark's.	"		60	Griffin.	"	976
.....	Barnett's.	"	647	70	Brooksville.	"	
15	Sugar Valley.	"		78	Senoia.	"	
21	Skelley's.	"		86	Sharpsburg.	"	
39	Rome.	Knox Shale.	627	96	Newnan.	{ Meta. Snake Creek Factory, m.	959
45	Six Miles.	"	684	.....	Whitesburg.	Metamorphic.	
56	Cave Springs.	"	672	123	Carrollton.	"	
63	Pryor's.	Potsdam.	819	0	Tennille.	19 a. Tertiary.	
76	Anderson's, Ala.	4 b. Quebec or Knox	702	4	Sandersville.	"	
Western & Atlantic Railroad.				East Tennessee, Virginia & Georgia R. R.			
0	Atlanta.	Metamorphic.	1050	351	Rome.	2-4. Lower Silurian.	
23	Marietta.	"	1183	349	Atlanta Junc.	"	
34	Acworth.	" Gold mines.	926	349	Silver Creek.	"	
40	Allatoona.	"	878	339	Brice.	"	
48	Cartersville.	{ Knox Shale, Pots- dam s.s., 1 m. east	760	337	Seney.	"	
68	Kingston.	Knox Shale.	710	335	Hamlet.	"	
78	Adairsville.	"	710	329	Rockmart.	Primordial & Canadian	
84	Resaca.	Cal. & K. Shale.	654	323	Braswell.	Primordial.	
90	Tilton.	Tren. & K. Dolomite	665	317	McPherson.	1. Archæan.	
99	Dalton. ¹³	" Red Marble.	757	312	Dallas.	"	
107	Tunnel Hill. ¹⁴	K. Sh. and K Dol.	853	306	Hiram.	"	
				301	Powder Springs.	"	

12. Ladd's lime kiln, 3 miles; Rockmart slate quarries, 20 miles; Ward's ferro manganese furnace, 11 miles; Bear Mountain, fine view, 18 miles; Etowah rolling mill site at Falls, 5 miles. Ocoee Conglomerate here and at Rowland Springs, also 5 miles from Cartersville. Flexible sandstone 13, and manganese 3 and 10, and iron ore beds 3, 5, 7 and 10 miles.

13. *Dalton* is situated upon a synclinal, the ridges on each side being Knox Dolomite, and the intervening valley in which most of the town is built is made up of Chazy and Trenton Strata. The fossils of the last named group may be seen in the limestone exposed on Hamilton Hill, immediately north of the town. The Chattooga Mountain, four miles west, is Upper Silurian.

14. *Tunnel Hill*. The tunnel here is cut through a ridge of Knox Dolomite. The Calceiferous and Potsdam is in close proximity to the town on the western side.

15. *Ringgold*. The Upper Silurian occurs in a high sandstone ridge immediately east of the town. The groups here well represented are Medina and Clinton with red fossiliferous iron ore. Oriskany fossils are found abundantly in a single bed of about one foot in thickness. These beds are followed on the east by Devonian and Sub-Carboniferous strata.

Note. The Knox Shale and Knox Dolomite of Prof. Safford extends from Tennessee into Georgia, with all the Tennessee characteristics of the groups.

East Tennessee, Virginia & Georgia R. R.*—			Northeastern Railroad of Georgia.		
Ms.	Continued.	Alt.	Ms.		Alt.
296	Austell.	1. Archæan.	0	Athens.	1. Archæan.
293	Mableton.	"	8	Center.	"
286	Chattahoochee.	"	12	Nicholson.	"
285	Peyton.	"	19	Harmony Grove.	"
279	Atlanta.	"	26	Maysville.	"
272	Constitution.	"	32	Gillsville.	"
268	Moore's Mill.	"	39	Lula.	" Stacolumite.
265	Ellenwood.	"	.....	Bellton.	"
259	Stockbridge.	"	.....	Longview.	"
250	McDonough.	"	51	Babun Gap.	"
243	Locust Grove.	"	59	Clarksville.	"
232	Jackson.	"	68	Anandale.	"
227	Indian Springs.	"	68	Turnersville.	"
218	Frankville.	"	72	Tallulah Falls.	"
206	Dames' Ferry.	"	Georgia Pacific Railroad. The portion of this road in Georgia will be found in the chapter on Alabama.		
199	Holton.	"			
190	Macon.	19. Tertiary.			
Elberton Air Line Railroad.					
0	Toccoa.	1. Archæan.			
12	Martin's.	"			
24	Bowersville.	"			
26	W. Bowersville.	"			
39	Bowman.	"			
51	Elberton.	"			

* This and the following railroads by Prof. A. R. McCutchen.

Alabama.

DANA'S TABLE OF FORMATIONS.	ALABAMA DIVISIONS BY PROF. GESNER.	DANA'S TABLE OF FORMATIONS.	ALABAMA DIVISIONS BY PROF. GESNER.
20. QUATERNARY.	20 c. Alluvium.	10 c. GENESEE.	10 c. Black Shale.
"	20 b. Bluff Loam.	7. L. HELDERBERG.	7. Lo. Helderberg.
"	20 a. Orange s. ordt.	5. NIAGARA.	5 d. Niagara l. s.
19. TERTIARY.	19 c. Pliocene.	5. CLINTON.	5 c. Dyestone Group
"	19 b. Miocene.	5. MEDINA.	5 b. Wh. Oak Mt. s.s.
"	19 a. Eocene.	"	5 a. Clinch Mt. s. s.
18. CRETACEOUS.	18 c. Upper Creta's.	4. TRENTON.	4 b. Cincinnati.
"	18 b. Middle Creta's.	"	4 a. Trenton.
"	18 a. Lower Creta's.	3. CANADIAN.	3 c. Chazy.
17. JURASSIC.	17 b. Marlstone.	"	3 b. Quebec Knox dolomite.
"	17 a. Lower Lias.	"	3 a. Calcareous.
14. CARBONIFEROUS.	14 c. Upp. Coal Mrs.	2. PRIMORDIAL OR CAMBRIAN	2 b. Potsdam s. s.
"	14 b. Low. Coal Mrs.	"	"
"	14 a. Millstone Grit.	1. ARCHEAN.	2 a. Acadian.
13. SUB-CARBONIF.'S.	13 b. Mountain l. s.	"	1 b. Huronian.
"	13 c. Coral or St. L. ls	"	1 a. Laurentian.
"	13 a. Barren Group.		

South and North Alabama, or Louisville Ms. and Great Southern Railroad. Alt.		South and North Alabama, or Louisville Ms. and Great South. Railroad.—Con. Alt.	
0 Decatur.	13 b. L. Ca., St. Louis ⁵⁷⁷	90 Grace's Gap. ⁵	(See foot note.)
7 Flint.	" 569	93 Oxmoor.*	14. Cahawba c. fld 682
13 Hartsell's.	" 673	95 Shade Creek.	"
18 Falkville.	" 603	99 Brock's.	" 564
23 Wilhite's.	" 603	102 Cahaba Mines. ⁶	" 400
28 Summit. ²	14 b. War'r coal	104 Helena. ⁷	{ 3 a. Calcifer's fault.
31 Milner's.	field. " 540	109 Siluria.	{ 14 b. Coal Meas. 400
33 Cullman's.	" 502	112 Whiting's.	{ 3 c. Chazy and 444
35 Phelan's.	" 602	119 Calera Hills.	{ Tren. Lime Wks. 555
42 Hanceville.	"	125 Clear Creek.	{ 13. Sub-Carbon., 3 c.
49 Bangor.	" 468	130 Jemison.	{ Chazy & 4 a. Tren 502
52 Blount Springs. ³	{ 13 b. Up. Sub. Carb.	135 Strasburg.	1 b. Metamorphic. 540
57 Reid's. ²⁰	{ 13 a. Low. Sub. Carb.	139 Lomax.	" 706
63 Warrior. ⁴	{ 10 c. Blk. Shale. 434	141 Clanton.	"
68 Morris.	14 b. War'r cl. field ⁵⁹²	148 Cooper's.	" 458
74 Cunningham.	" 549	151 Verbena.	" 450
76 New Castle. ²¹	408 " Jeffe. Cl. Co.	155 Mountain Creek.	20. Quaternary. 542
79 Black Creek.	440 " N. C. Cl. & I.	164 Deatsville.	" 300
81 Boyle's Gap. ²²	Coalburg Co's colliery.	170 Elmore.	" 199
86 Birmingham'm. ⁵⁺²³	14 b. War'r cl. field ⁵²⁴	174 Coosada.	" 175
	{ 4 a. Trenton.	179 Alabama River.	18. Cretaceous.
	{ 3 c. Chazy 602	..... Commerce St. Ju.	" rotten l.s.
	{ 3 b. Quebec.	182 Montgomery.	" 162
	{ 3 a. Calcifer.		

1. Prepared expressly for this work by Prof. William Gesner, of Birmingham, Ala., Geologist and Analytical Chemist, and by Prof. Eugene A. Smith, the State Geologist.

2. Ascending the mountain from Wilhite's to Summit, Flint Creek shows looming above it cliffs of millstone grit, sandstone and shales, as seen from the car windows. W. G.

3. White and red sulphur and Chalybeate waters of great sanitary value at Blount Springs are much resorted to, particularly in the summer season, from all the States; and the Jackson House, by S. D. Holt, is a well kept hotel. The 10 c. Black Shale gives rise to the sulphur springs. The mountain on west side is 14 a. Carboniferous. W. G.

4. The Pierce Coal Mine Company and Alabama M. & M. Company's mines here. W. G.

* Eureka furnaces and coke ovens.

Selma, Rome & Dalton Railroad, or Blue Mountain Route.			Alt.	Alabama Great Southern Railroad— Continued.			Alt.
0	Selma.	18. Cretaceous.	147	28	Cloverdale.	4 c. Cin. & 4 a. Trenton	
9	Burnsville.	"	207	32	Sulphur Sp'gs. ²⁴	13 a. b. L. Sub-Carb. ⁸⁸⁸	
22	Plantersville.	20. Quaternary.	266	34	Eureka.	"	960
32	Maplesville.	"		40	Valley Head.	"	1012
40	Randolph.	"	381	46	Hollman's. ²⁵	"	918
49	Ashby.	"	471	51	Fort Payne.	"	864
51	Briarfield. ⁸	3 b. Knox Dolomite ⁴¹⁸		56	Brandon's.	"	877
55	Montevallo. ⁹	3 a. Calcifer's, 1 m. ⁴⁹⁴		61	Porterville.	"	
		3 b. Quebec, 5 miles.		65	Collinsville.	"	710
62	Calera.	{ 3c. Cha., Tren & ridge of 13 a. Sub-Car. ⁵²²		74	Greenwood.	"	672
.....	Gardner's.	14. Coosa coal field. ⁵⁶⁷		82	Reases.	"	580
67	Shelby Spr'gs. ¹⁰	"	554	87	Attalla. ²⁶	"	588
72	Columbiana. ¹¹	3 b. Quebec or Knox ⁵⁶⁰		95	Steele's. ²⁷	"	591
82	Wilsonville.	"	552	102	Whitney or Ashville.	"	594
.....	Coosa River. ¹²	"	445	115	Springville. ²⁸	3 b. Quebec or Knox ⁷⁰⁸	
.....	Coosa Station.	"	472	131	Trussville.	13 a. b. Sub-Carb. ⁶⁸⁸	
90	Childersburg.	"	441	137	Irondale.	5 b. Clinton.	
99	Alpine. ¹³	"	495	143	Birmingham.	{ 4 a. Tren. & 3 c. b. & a. of Can. anti. axis ⁵⁷⁷	
109	Talladega. (Alabama Fur.)	"	586	155	Jonesboro.	3 c. and 3 b. Cana. ⁵⁰⁸	
126	Munford.	"	646	167	Tannehill. ¹⁸	3 b. or 3 a. Canadian ⁴⁹⁵	
.....	Silver Run. ¹⁴	"	655	170	Woodstock. ³⁰	3 b. Quebec or Knox ⁵⁰⁰	
180	Oxford. ¹⁵	"	678	174	Red Gap. ²⁹	3 b. Knox Dolomite.	
131	Anniston.	" Woodstock		178	Vances.	"	410
139	Weaver's.	" Iron Wks.		183	Clement's.	14b. War'r coal field ²⁶⁹	
145	Jacksonville.	"	653	191	Cottdendale.	"	
156	Patona.	"	714	198	Tuscaloosa.	20. Quat. over L. Cre ¹⁶²	
.....	Cross Plains.	"	722	204	Maxwell's. ³¹	"	157
.....	Ladiga.	696 " Tecumseh		213	Carthage.	"	
160	Amberson.	727 " Iron Co.		.....	Stewart's or Havana.	"	
164	State Line. ¹⁶	930 " Stonewall Ir.		223	Akron.	18 b. Rotten l. s. ¹⁷⁰	
168	Pryor's, Ga.	5 b. Clinton. ⁸⁴⁴ [Works		233	Eutaw.	"	
170	Cave Springs.	4 a. Trenton. ⁶⁹⁷		239	Haysville.	"	
172	Rome, Ga.	"	652	243	Boligee.	"	
Alabama Great Southern Railroad. ¹⁸				250	Epps.	"	
0	Chattanooga, T ¹⁹	4 a. Trenton	665	259	Livingston.	"	
6	Wauhatchie, "	4 b. Cincinnati.	671	263	Hooks.	19 a. Tertiary, 36 miles	
9	Wildwood, Ga.	4 a. Trenton.		269	York.	"	159
12	Morganville, Ga.	"		274	Cuba.	"	219
18	Trenton, Ga.	"	720	279	Kewanee.	"	
23	Dademon, Ala.	"	818	283	Toomsaba.	"	276
26	Rising Fawn.	4 c. Cin. & 4 a. Tren. ⁷⁷⁸		290	Russell's.	"	398
				295	Meridian, Miss.	"	819

5. The prosperous city of Birmingham is in Jones' Valley. The railroad then passes through Red Mountain by Grace's Gap. The rocks of the anticlinal axis show, at the junction of the Lower Carboniferous with the 5 c. Clinton, an exposure of Fossiliferous Hematite Iron Ore, 28 feet thick, which is being used in the production of an excellent quality of Iron by the Eureka Company, at Oxmoor, at the next station. This bed of iron ore extends from a few miles below Pratt's Ferry on the Cahaba River, in Bibb County, through St. Clair, Cherokee and De Kalb counties, into Tennessee, a distance of 120 miles.

6. S. D. Holt and Davis and Carr's collieries.

7. Eureka Company's colliery and Central Iron Works Company, at Helena.

8. Branch railroad to Briarfield Rolling Mills and Furnaces.

9. Cahaba coal field on the west, with branch railroad to the Montevallo coal mines of Dr. T.

H. Aldrich.

10. Shelby Springs, Chalybeate and sulphuretted Hydrogen water of great renown, and much frequented.

11. Columbiana branch to Shelby Iron Works.

12. From Coosa River to Childersburgh, mountains of 2 b. Potsdam sandstone are seen to the southeast from car windows.

13. From Alpine to Talladega, 2 b. Potsdam sandstone mountains on the west, and 2 a. Acadian slate hills toward the east.

14. At Silver River, 2 a. Acadian on the east, and 2 b. Potsdam on the west.

W. G.

W. G.

W. G.

W. G.

W. G.

W. G.

W. G.

W. G.

E. A. S.

E. A. S.

E. A. S.

E. A. S.

Ms. Memphis & Charleston Railroad. Alt.			Ms. Nashville & Chattanooga R. R. Alt.		
0	Memphis.	20. Qua., bluff loam ²⁴⁵	.....	Stevenson Junc.	3 b. Quebec or Knox.
5	Buntyn.	" 303	.....	Bass Station.	"
9	White's.	" 378	49	Anderson.	13 a. Sub-Carbon.
15	Germantown.	" 378	39	Stevenson.	3 b. Quebec or Kn. ⁵⁰²
19	Bailey's.	{ 19. Tertiary, Orange Sand, LaGrange group.	29	Bridgeport.	3 c. Canadian.
23	Collierville.		22	Shellmound.	20. Quat., Alluvium.
31	La Fayette.		14	Whiteside.	14 b. Coal Mrs. & 13 c.
39	Moscow.		(Etna Coal Mines.)		
52	Somerville.	"	6	Wauhatchie.	4 b. Cincinnati. ⁶⁷¹
49	La Grange.	" 521	0	Chattanooga. ¹⁹	4 a. Tren. & 3 c. Can. ⁶⁰³
52	Grand Junction.	" 575	Nashville & Decatur Railroad.		
58	Saulsbury.	" 535	0	Decatur	13 b. L. Sub-Carb. ⁵⁷¹
64	Mile Siding.	19. Ter., Porter's Ck.	3	Harris Station.	" 564
74	Pocahontas.	" 394	13	Athens.	" 709
79	Big Hill.	18. Cre., green sand.	22	Elkmont.	13 a. Sub-Carb. 773
84	Chewalla.	" 409	.....	Pittensville.	"
93	Corinth, Miss.	18 c. Ripley group. ⁴⁸⁴	27	State Line.	13 a. L. Sub-Car. or bar.
107	Burnsville.	" 463	Western Railroad of Alabama.		
115	Iuka.	13 b. a. Sub-Carbon ⁵⁵⁵	0	West Point.	1. Archæan.
124	Margerum, Ala.	" 488	11	Cusseta.	"
127	Dickson.	" 498	13	Mt. Jefferson.	"
129	Cherokee.	" 498	18	Rough & Ready.	"
133	Barton.	" 468	22	Opelika.	" & 20. Quat.
139	Pride's.	" 563	28	Auburn.	20. Quaternary.
145	Tuscumbia.	" 560	35	Loachapoka.	"
156	Leighton.	" 599	42	Notasulga.	"
163	Town Creek.	" 534	Fisher Branch—(Narrow Gauge to Tuskegee.)		
169	Courtland.	" 573	48	Chehaw.	20. Quaternary. 252
176	Hillsboro.	" 601	(To Tallahassee Factory.) 1 b. Huronian.		
182	Trinity.	" 601	56	Cowles' Station.	20. Quaternary.
188	Decatur.	" 573	65	Shorter's.	b. Cre., rotten l. s.
195	Mooresville.	" 573	75	Mt. Meigs.	" 162
203	Madison.	" 601	88	Montgomer.	"
212	Huntsville. ³²	{ 14 a. b. Coal Meas. 13 c. Sub-Carb. 612 13 b. St. Louis l. s. " 631	101	Manack.	"
223	Brownsboro.		107	Lowndesboro.	"
229	Gurley's.		113	Whitehall.	"
233	Paint Rock.		119	Benton.	"
237	Woodville.	13 b. Sub-Carbon. 596	127	Alabama River	"
248	Larkinsville.	" 601	138	Selma.	" 121
254	Scottsboro.	" 620	Columbus Branch.		
259	Bellefonte.	" 652	0	Columbus.	1 b. Huronian. 262
265	Fackler's.	" 639	4	Smith's or Dover.	"
271	Stevenson.	{ 3 b. Quebec or Knox Dolomite, with hills of Sub-Carbon and Coal Meas. ⁶⁰³	6	Mott's Mill.	20. Quaternary
			8	Salem.	"
			19	Hollis.	1. Archæan.
			25	Yonges.	"
			29	Opelika.	" 311

15. At Oxford, the railroad crosses through a gap of 2 b. Potsdam, and thence to Cross Plains the mountains of 2 b. Potsdam are on the east side. Beyond Cross Plains, to the State line, these mountains can be seen from the cars.

16. The railroad is built on 3 b. Quebec or Knox dolomite almost all the way from Montevallo to the State line, crossing 3 c. Chazy and 4 a. Trenton near Calera and the Coosa coal field above Calera.

17. Yongesborough narrow gauge railroad, $2\frac{3}{4}$ miles to Chewackla Line Company's kilns, south-east. The limestone of this company's quarries is a highly crystalline dolomite.

18. The hills on the west of the railroad consist principally of limonite, and their detritus constitutes the bright red banks of the cuts and fills for many miles. The Thomas ore bank is on east.

Mobile & Girard Railroad.		Alt.	Mobile & Alabama Grand Trunk R. R.		Alt.
		Ms.			
Blumhus, Ga.	1. Archæan.	262	0 Mobile.	19. Tertiary.	6
Port Mitchell.	18. Cretaceous.		9 Cleveland.	"	15
Osale.	"		20 Cold Creek.	"	34
atchechubbee.	"		29 Mount Vernon.	"	49
urtville.	"		39 Leona.	"	54
erryton.	"		50 Sunflower.	"	23
nion Springs.	494 " Ripley Gp.		59 Jackson.	"	42
omas Station.	"		Mobile & Ohio Railroad.		
nwood.	"		Part in Alabama.		
nesville.			0 Mobile.	19. Tertiary.	6
oy.	19. Tertiary.		5 Whistler.	"	41
Mobile & Montgomery Railroad.			18 Chunchula	"	73
ontgomery.	18. Cretaceous.		33 Citronelle.	"	317
cGehee's.	" rotten l. s.		44 Deer Park.	"	143
organsville.	"		51 Escatawpa.	"	
stohatchie.	"		63 State Line.	"	256
alhoun.	"		Alabama Central Railroad.		
Port Deposit.	520 " Ripley Gp.		0 Selma.	18. Cretaceous.	121
reenville.	19. Tertiary.		..... Marion Junction.	253 " rotten l. s. gp.	
olling.	"		23 Brown's.	"	252
orgiana.	"		30 Uniontown.	"	
arland.	"		35 Fawnsdale.	"	
adge's Mills.	"		42 Macon.	"	
ravella.	"		..... Van Buren.	"	
vergreen.	"		50 Demopolis.	"	
arta.	"		66 Coatopa.	" Ripley Gp.	
stleberry.	"		81 York.	19. Tertiary.	159
rewton.	"		..... Cuba.	"	219
illard.	"		..... Toomsuba.	"	
hitting or Pensa	cola Jun. 19. Tertiary.		108 Meridian.	"	
illiams.	"		Montgomery & Eufaula Railroad.		
ay Minette.	"		0 Montgomery.	18. Cretaceous.	162
nsas River.	"		10 Oak Grove.	226 " rotten l. s.	
obile.	"		13 Perry's Mill.	"	
Selma & Gulf Railroad.			16 Pike Road.	"	293
lma.	18. Cretaceous.	147	21 Matthews'.	"	262
asant Hill.	" rotten l. s.		25 Mitchell's.	"	253
ow Hill.	" Ripley Gp.		28 Fitzpatrick's.	"	262
llenton.	19. Tertiary.		33 Thompson's.	"	259
ne Apple.	"		Crossing of Mobile & Girard Railroad.		
okerville.	"				

close to the main track, nearly opposite the station house. The hills seen beyond these belong to the Warrior coal field. (W. G.)

In addition to the 4 a. Trenton, there are, within the limits of the city of Chattanooga the 3 b. Carboniferous, 4 b. Cincinnati, 5. Clinton, 10 a. Black shale, and 14. Carboniferous formations.

[J. Safford.]

Roids. Branch railway, 3 miles, of the Warrior Coal and Coke Company to mines working the 10 bed. (W. G.) The Pierce Warrior Coal Co. working the Warrior Coal bed. The Watts Coal Co., working the Watts bed. (W. G.)

Newcastle. Branch railway of Milner Coal and Railway Company, working the Black Creek Also in the Warrior coal field. (W. G.)

At *Boyle's Gap* the railroad passes from the Coal Measures, between almost perpendicular of 14 a. Millstone grit, into Jones Valley. E. A. S.

Birmingham. Branch railway, 12 miles. The Birmingham Mineral Railway Station, between the Furnace and Rolling Mills, following the foot of Red Mountain down Jones Valley, principally the Knox, with the upper Silurian and Clinton Hematite Ore beds to be seen all the way, as stated on the western brow of the Red Mountains nine miles south of Birmingham. (W. G.) Coal and Coke Company's railway nine miles westerly to Coketon mines on the Warrior coal Pratt coal mines on the Pratt bed, capacity 500 tons per day. (W. G.)

From *Sulphur Springs* down to Attalla, the railroad follows the valley lying between Lookout Mountain, 14 a. b. on the east, and the Red Mountain Ridge (5 c., 10 c. 13 a.) on the west, and the 3 are upon the Lower Sub-Carboniferous, 13 a. and b. E. A. S.

Montgomery & Eufaula Railroad— Continued.			Vicksburg & Brunswick Railroad.		
Ms.		Alt.	Ms.		Alt.
40	Union Springs.	18. Cre., Ripley Gp. 494	0	Eufaula.	18. Cre., Ripley Gp. 100
50	Three-Notch R'd.	" 492	5	White Oak.	"
54	Midway.	" 506	25	Clayton.	" or Tertiary
62	Spring Hill.	" 512	Anniston & Atlantic R. R. (Narrow Gauge.)		
66	Batesville.	" 280	0	Anniston.	Quebec and Knox.
74	Cochran.	"	.....	Jenifer.	"
81	Eufaula.	{ 18. Cre., marl bluff of the Chattahoochie R. Ripley Group. 200	.....	Munfroid.	"
			.....	Irona.	"
			.....	Talladega.	" 561
Selma, Marion & Memphis Railroad.			28	Sycamore.	"
.....	Selma.	18. Cre., rotten l. s. 147	The Birmingham Mineral Railroad. Branch of the N. & S. Alabama R. R.		
0	Marion Junction.	"	0	Birmingham.	{ 4 a. Tren., 3 c. Chazy, 3 a. Cal., 3 b. Que. 615
14	Marion.	" 258	3	Magella.	3 c. Chazy.
21	Grove Cottage.	"	6	Newton.	"
29	Newbern.	"	9	Alice.	{ Hematite ore bk. in 5. Clin. of Alice Fur. Co.
87	Greensboro.	"	10	Woodward.	{ Hematite ore bk. in 5. Clin. Wood. Iron Co.
45	Sawyersville.	"	12	Sloss Mines.	{ Hematite ore bk. in 5. Clin. Sloss Fur. Co.
Savannah & Memphis Railroad.			Montgomery Southern Railroad. (Narrow Gauge.)		
0	Opelika.	1. Archæan. 819	0	Montgomery.	Cretaceous. 168
10	Gold Hill.	" 770	6	Catoma.	"
15	Waverly.	" 805	10	Snowden.	"
22	Camp Hill.	" 738	13	Pleasant Grove.	"
30	(Dudleyville gold mines).	1. Archæan. 760	17	Reamer.	"
			20	Ada.	"
35	Jackson's Gap.	" 695	Wetumpka Branch S. & N. Alabama Railroad.		
40	Sturdevant.	" 502	0	Decatur.	" 578
42	Salisbury.	"	170	Elmore.	20. Qu. over 1 b. Hu. 197
47	Alexander City.	" 747	184	Wetumpka.	1 b. Huronian. 188
53	Kellyton.	" 800			
60	Goodwater.	Steatite (soaps s.) qr. 872			
East Alabama & Cincinnati Railroad.					
0	Opelika.	1 b. Huronian. 819			
10	Oak Bowery.	"			
23	Buffalo Wallow.	"			

25. *Hillman Station.* Branch railway, southeast, $1\frac{1}{2}$ miles long, leaving Quebec or Knox and entering 5 c. Clinton of Red Mountain terminus at the Alice Furnace Co.'s Hematite Mines. $10\frac{1}{2}$ miles south of Birmingham, *Wheeling*, station No. 1, branch railway leaving Quebec or Knox and entering Coal Measures of the Warrior Coal field terminus, $5\frac{1}{2}$ miles northwest Woodward Iron Co.'s mine on the Pratt coal bed. Also, branch railway, southeasterly, $2\frac{1}{2}$ miles to terminus in 5 c. Clinton Hematite ore mines of The Woodward Iron Company. (W. G.)

26. At *Attalla* Lookout Mountain ends abruptly, and the Red Ore Ridge rises to a considerable height on west. Just south of Attalla, through a gap in Red Mountain, the escarpment of Blount Mountain, 14 a. b., is seen to westward. E. A. S.

27. From *Steele's* to near Whitney, Chandler's Mountain, 14 a. and b., is seen on the west, and below Steele's to Springville the ridge on the west is Red Mountain (5 c., 10 c., 13 a.) All the stations from Attalla to Springville are on Knox Dolomite or Knox shale, 3 a., 3 b. E. A. S.

28. A short distance below *Springville* the road enters the valley between a Red Ore Ridge on the west and the Cahaba coal field on the east, and continues thence to Irondale. E. A. S.

29. At *Red Gap* the railroad passes from 13 b. Sub-Carboniferous at Irondale, through a gap in Red Mountain (made up of 5 c., 10 c. and 13 a.) in Jones Valley. Thence to Vances down Jones Valley. At Vances, road enters Warrior coal field and passes out of it at Tuscaloosa. Below Tuscaloosa to Eutaw the surface material is Quaternary, but it overlies the Lower Cretaceous beds, and perhaps beds still older than Cretaceous. Just below Eutaw the rotten limestone begins and is left at Livingstone, where the road enters Tertiary formation, continuing in it to Meridian. E. A. S.

30. *Woodstock.* Here is Edward's Furnace and a branch railway, almost due south, nine miles, leaving Quebec or Knox and passing over Sub-Carboniferous into Coal Measures of the Cahaba coal field, having passed over the southwesterly extremity of the Clinton ore bed of Red Mountain in Alabama terminus, at two coal mines about two miles apart, Blocton being the first one said to be on the Montevalle coal bed. All the property of the Cahaba Coal Mining Co. (W. G.)

31. *Marwells.* Carthage and Stewart are on Quaternary, overlying a formation older than Cretaceous, but whether Jurassic, Triassic or Permian, not yet determined, probably the former. E. A. S.

32. *The Mountains about Huntsville* are outliers of the Cumberland Mountains capped with 14 a. and b. Coal Measures, and showing on their flanks Mountain limestone 13 c. and underlying beds down to 13 b. Saint Louis limestones. E. A. S.

Georgia and Alabama.

Georgia Pacific Railway.**		Alt.	Georgia Pacific Railway— Continued.		Alt.
nta, Ga. ⁸³	{ 1 b. Huronian, Mica, Slates & Schists ¹⁰⁵⁰	18	Austell.	{ 1 a. Lauren. and 1 b. Huronian.	940
ell.	{ 1 b. Huro. Gneiss in Mica Slates. ⁹⁶²	21	Salt Springs.	"	1055
on.	" " ⁸⁶⁹	27	Douglasville.	1217 " Granite.	1182
tahocoochee.	1 b. Hu. Mica Slates ⁸²²	32	Winston. ⁸⁴	"	1160
" River.	{ 1 a. Lauren. 1 b. Hu. Granite in bed of River. ⁸⁰⁹	38	Villa Rica. ⁸⁵	1160 " Gold Mine.	
ord.	{ 1 a. Lauren. and 1 b. Huronian. ⁸⁶⁷	45	Temple. ⁸⁶	{ 1 b. Huronian, Horn- blende, Slates and Schists. ¹¹⁶⁰	1424
leton.	" " ⁹⁹⁵	52	Summit.	"	1413
etwater.	" " ⁹¹⁴	54	Bremen.	"	1343
		56	Waco.	"	962
		68	Tallapoosa River.	"	

geology of this road is furnished by Professors J. L. & H. D. Campbell, of Washington and University, Lexington, Va., and where not otherwise credited the notes are by them also. Edited by W. G. are by Dr. Wm. Gesner, of Birmingham, Ala.

Atlanta. The broad belt of METAMORPHIC ROCKS, extending from Maryland to central Alabama to the Archæan age. It has the Blue Ridge of Virginia, the Unica of Tennessee, and the Mountain of Georgia for its northwestern border. Its southwestern margin is approximated by the falls and shoals of the rivers at Washington, D. C., at Richmond and Petersburg, at Raleigh, N. C., at Columbia, S. C., at Augusta, Milledgeville and Columbus, Ga., and at Wetumka, Ala. An air line from Milledgeville, passing near Atlanta to the limit of the gneiss rocks, would measure the width of the Archæan belt in Georgia, showing it to be about 100 miles wide.

Archæan rocks are recognized in Georgia under only two divisions, 1 a. Laurentian and 1 b. Huronian. They constitute the country rocks from Atlanta westward to the margin of Choccolocco at Davisville Tunnel, Alabama, 88 miles. The 1 a. Laurentian group consists chiefly of granites and hard schists; while the 1 b. Huronian group consists of less metamorphosed beds of micaceous and talcosa schists and slates, and some beds of argillites. Both groups are along the railway cuts, but 1 b. Huronian constitutes by far the greater portion of the surface.

The hard rocks of the 1 a. Laurentian, however, are exposed to view in the bed of the Peach River, eight miles west of Atlanta, and are quarried a short distance west of the river. The 1 b. Huronian also occurs, as shown by the Guide, in the excellent granite quarried at Douglas at Villa Rica. *Concord* to Douglasville, mica and Hornblende slates and schists with beds of gneiss exposed in cuts along railroad. From this point westward to the limit of the rocks in Alabama the beds of the 1 a. Laurentian are but little exposed.

Winston. Corundum has been found in considerable quantities near Powder Springs, in Georgia; also near Villa Rica, Ga., and in Tallapoosa County, Ala.

Villa Rica. The granite beds make their appearance near Villa Rica, where they seem to the hornblende schists and slates that carry the copper ores (chalcocopyrites) of that region, the mica schists in which the gold-bearing veins of quartz in the same vicinity are found. The copper ore (chalcocopyrite) crosses the Georgia Pacific Railway, west of Villa Rica, in Carroll County. This ore has been mined to some extent at several points in Douglas, Carroll and Haralson Counties.

It is transported to Atlanta where the copper is extracted and the sulphur utilized in the manufacture of sulphuric acid. The same belt of copper ore continues its southeasterly course into Georgia, Ala., where the Wood Copper Mines were worked for some years.

Old belt of the Atlantic Slope extending from the Potomac in Virginia, and across North Carolina through the northwestern portion of Georgia and terminates in Alabama. It is intersected by the Georgia Pacific Railway at Villa Rica and other points between that and the State line. The gold was very extensively mined forty or fifty years ago; also at Arbacoochee, Cleburne County, Alabama, and at other points in both States.

Temple. Mica, talc and asbestos are found in Cobb, Douglas and Carroll Counties, Georgia, and in Cleburne County, Alabama. Roofing slates and flagging stones have been quarried in Polk and Carroll Counties, Georgia, and are found in Cleburne County, Alabama.

J. L. & H. D. C. From Muscadine to Heflin, metamorphic slates and schists, chloritic and micaceous with some quartz. Southwest of Heflin Station, 14 miles in Cleburne County, are the celebrated Arbacoochee gold mines; and in Randolph County, near Heflin, are the Goo, Smith's and Wood's copper mines; and in Randolph County, near Heflin, are the tin ores lately discovered by Wm. Gesner, Analytical Chemist, Birmingham, Alabama.]

Davisville. Soon after passing the tunnel near Davisville, the road leaves the Archæan rocks as abruptly upon the Lower Silurian sandstones, limestones and slates of the beautiful Choccolocco Valley. These sandstones, slates and limestones, of Cambrian and Lower Silurian age, along the east margin of the valley, apparently dip under the older Archæan beds, which seems to be due to the fact that the Cambrian rocks have slipped downward, while by an inversion the Archæan rocks have been thrown upon them, so as to give a reversed order of superposition. From Davisville

ALABAMA.

Georgia Pacific Railway—			Georgia Pacific Railway—		
Ms.		Alt.	Ms.	Continued.	Alt.
70	Muscadine. ³⁷	941	134	Eden. ⁴²	{ 14. Coosa Coal Field,
72	Main's Gap.	1118			{ 18. Sub-Carbon. ⁵²²
78	Edwardsville.	923	139	Cane Creek Tun.	14 b. Coosa Cl. Fd. ⁶²²
84	Heflin. ³⁷	988	140	Cook's Springs.	" ⁶¹⁹
87	Davisville Tun.	{ 1 a. Lauren., 1 b.	143	Bald Rock Mt.	{ 14 b. Coosa Coal Fd.
		{ Huron, nr. fault. ⁹⁴⁸			{ & Millstone Grit. ⁷²⁴
90	Davisville. ³⁶	{ 3 b. Silurian and l.s.	144	Kerr's Gap. ⁴³	" ⁷⁵⁴
		{ Iron Ores. ⁷⁷⁸	146	Brompton.	{ 3 b. c. Quebec & Chazy
93	Choccolocco.	" ⁶⁸²			{ Silurian Valley. ⁷⁴⁶
97	De Armanville.	622 " Linamite Ores.	147	Summit.	"
101	Oxford. ³⁹	{ 2 b. Potsdam, Sand-	150	Leeds.	{ 14 b. Cahaba Coal
		{ stone and Shale. ⁶⁵⁰			{ Fields. ⁶⁵¹
103	Junction.	3 b. Alluvium. ⁶⁸²	151	O'Barr's Gap. ⁴⁴	" ⁷¹¹
104	Anniston. ⁴⁰	622 " ore & drift.	153	Cahaba River.	" ⁵⁹⁹
112	Berclair.	{ 3 b. c. Quebec and	158	Weems' Gap.	622 " & 18. Sub-Carb.
		{ Chazy. ⁶⁴⁸	161	Irondale.	18 a. Sub-Carbon. ⁷⁰⁰
116	Estaboga.	522 " lime, ore.			{ 5 b. c. Clinton and
122	Lincoln.	" ⁵⁰⁵	162	Red Gap. ⁴⁵	{ 10 c. Genesee. ⁷⁶⁸
127	Coosa River.	" ⁴⁸⁸	167	Birmingham. ⁴⁶	3 b. Queb. & 3 c. Chy. ⁸¹¹
127	Riverside.	" ⁴⁸⁹			{ 14 b. Warrior Coal
129	Seddon. ⁴¹	" ⁵⁰⁰	177	Coalburg. ⁴⁷	{ Field, Pratt seam.

Tunnel the road runs southwest for 12 miles, along the beautiful Choccolocco Valley, passing frequent cuts through Lower Silurian rocks, the lower portion of which are considerably metamorphosed—some of the beds being partially changed to Hydromica slates. *Limonite* ores are very abundant in this valley, are easily mined, and await only capital and labor to make them profitable.

39. Near *Oxford*, Calhoun County, the road changes its course northward through a gap of *Ladiga* Mountain, cut by *Snow Creek*. Here the sandstones and shales of the *Potsdam* group (2 b.) are exposed in well defined arches. These rocks constitute the main mass of the *Ladiga* and *Cold Water* Mountains—the ridges which flank the narrow valley in which *Oxford* and *Anniston* are situated. These ridges are two great stone-waves, between which we find a synclinal trough which holds the rich beds of *Limonite* ores, mined to supply the furnaces at *Anniston*. *Oxford* is a good starting point for the geological study of this region.

40. *Anniston*. From *Anniston* the railway turns westward and crosses the wide *Silurian* limestone valley of the *Coosa River*, the country rocks of which belong mostly to the *Quebec*, *Chazy*, and *Trenton* epochs.

41. *Shedden* station is on the western border of the *Coosa Valley*, upwards of 25 miles wide, diagonally as the railway crosses it; and a little east of *Eden* Station it passes abruptly into the *Sub-Carboniferous* formation of the *Coosa*, or third or most easterly *Alabama* coal field. (W. G.) The *Coosa Valley* is a prolongation of the great *Silurian Valley* of *Virginia* and *Tennessee*, while the *Choccolocco* and *Anniston* Valleys on the one side, and the *Cahaba* and *Birmingham* Valleys on the other, may be regarded as its branches or outliers. The width of the *Coosa Valley* by the line of the *Georgia Pacific Railway* is 25 miles. Many promising beds of iron ore are found near this line. The *Coosa Valley* is the southern terminus of one of the most interesting and important valleys in the World, in a geological view. Tracing the 4 a. *Trenton* limestone, and the 4 c. *Hudson River* slate formations from their classical localities, from which they derive their names, *Trenton Falls*, N. Y. (see note 62 of that State), and the *Hudson River*, we find them in the *Mohawk Valley* of *New York*, with branches extending far into *New England* and *Canada*. Following it southwestward it crosses *New Jersey* and southeastern *Pennsylvania* by *Easton*, *Lebanon*, *Harrisburg*, *Carlisle* and *Chambersburg*, as the *Cumberland* or *Kittatinny Valley*, into *Maryland*, past *Hagerstown* and through *Virginia* as the *Shenandoah* or *Great Valley*, by *Winchester* and *Stanton*; and, being divided by the *Massanutten Mountain*, on the east side by *Shepherdstown*, *Luray*, to *Roanoke*, and into *Tennessee*, where it is the valley of *East Tennessee*, and finally in *Alabama* its two divided branches sink and disappear beneath the *cretaceous* plains of the South. In *Alabama* the *Trenton* is much less conspicuous than the *Canadian* group. (3 a. b. c.) J. M.

42. *Eden*. [North of this station are the *Broken Arrow* and *Front Creek* coal mines, in the *Coosa* coal field. (W. G.)] A few miles west of *Coosa River* we find an abrupt transition to the *Sub-Carboniferous* of the *Coosa* coal field. Near *Eden* station the road passes through a ridge of *Sub-Carboniferous* limestone, directly upon the highest coal-bearing beds of this region, which dip beneath the older *Sub-Carboniferous* strata. This can be best accounted for on the hypothesis of a fault. *Sub-Carboniferous* fossils are found in this neighborhood in abundance. Promising seams of coal are found in this field and have been mined to some extent. The *Broken Arrow Wells*, valued for their mineral waters, are situated in this region.

43. *Kerr's Gap.* At Kerr's Gap, where the road passes from the Coosa field into Cahaba Valley, the Millstone Grit (here a coarse conglomerate, 80 to 100 feet thick) has a high outcrop on the Coosa or Bald Rock Mountain. Dipping beneath this are the Sub-Carboniferous formations, followed by the Silurian limestones, all dipping to the southeast. Valuable iron ores and limestones, with one good vein of Baryte are found here. Along the western margin of this valley the Silurian limestones have been abruptly cut off by a fissure, and the coal-bearing beds (14) of the Cahaba field have dropped down so as to abut against them. The geological structure of this field is very analogous to that of the Coosa field—both apparently *monoclines*, limited by faults along their eastern margins. Valuable coal mines have been opened here.

44. [*O'Barr's Gap* is in the western boundary of the Second or Cahaba coal field of Alabama; and as this railway crosses the Big or West Cahaba River, at Sycamore Ford, and keeps the face of its western bluff a considerable distance, a good view of the strata of shales, sandstone, and some of the Cahaba coal beds can be seen from the cars.] (W. G.)

45. *Red Gap.* The road passes from Sub-Carboniferous of Cahaba field into the Birmingham (or Jones) Valley through *Red Gap*, which presents a section of the Clinton group that carries the great bed, 30 feet thick, of fossil ore so extensively worked in this part of Alabama. Here the road cuts beds that are probably Genesee (10 c.)

46. *Birmingham* is a rapidly growing city, in and around which are several large iron furnaces and other manufacturing enterprises. Here ores, limestones, coal, and building material are found in unusual contiguity and abundance.

47. *Structure of the Alabama Coal Fields.* There is good reason to believe that the Coosa, Cahaba and Warrior coal fields were originally one common field, which, previous to the Appalachian Revolution, stretched across the areas that are now the Cahaba and Birmingham Valleys. But these valleys and their margins are now only the relics of a monoclinical uplift, in the one case, and of an irregular anticlinal stone-wrinkle in the other, which were thrust up so high and bent so sharply as to fracture, not only the coal-bearing strata on top, but also the underlying Sub-Carboniferous and Clinton beds and many of the Silurian limestones that now form the bottoms of the valleys.

48. When this railway has been extended westward from Coalburg until it meets its western division, now under construction east of Artesia on the Mississippi & Ohio Railway, it will traverse the Great Warrior coal field over its most productive portions. Between this coal field and the Mississippi it will cross a wide belt of timber, cotton and corn lands. The line will intersect every geological formation found in the Southern States, from the Archæan, at Atlanta, up to the Quaternary, and must always be an interesting route for scientific travellers.

J. L. & H. D. C.

Mississippi.¹

LIST OF GEOLOGICAL FORMATIONS IN MISSISSIPPI.

20. QUATERNARY.	20 e. Alluvial. 20 d. Yellow Loam. 20 c. Loess. 20 b. Port Hudson. 20 a. Orange Sand or Stratified Drift.	19. TERTIARY EOCENE.	19 e. Vicksburg. 19 d. Jackson. 19 c. Claiborne. 19 c. Burstone. 19 a. LaGrange.
		18. CRETACEOUS.	18 d. Ripley Group. 18 c. Rotten Lime & 18 b. Tombigbee S'd 18 a. Eutaw.
19. LATER TERTIARY.	19 f. Grand Gulf.	13. SUB-CARBON'S.	13 a. Keokuk or St. Louis Limes.

¹ By Prof. E. W. Hilgard, Berkeley, Cal., late State Geologist of Mississippi, but, owing to the distance, he was unable to correct the proof sheets.

Notes on the Geological Formations of Mississippi.

Brief descriptions of some formations peculiar to the Southern States seem to be required. Mississippi is a Tertiary and Cretaceous State, by far the greater portion of it being occupied by the former, if we leave out of consideration the strata of the Orange Sand, which undoubtedly forms the greater portion of the actual surface. These formations have been well studied and described by Professor Eug. W. Hilgard, from whose reports the following brief descriptions of the several subdivisions have been taken.

20 Quaternary.

20 e. *Alluvial Deposits*. These include all the soils, first bottom deposits, and sand bars now in process of formation, or attributable to causes now in action. The lower bottoms of the Mississippi River, now frequently overflowed, are bordered by level tracts of land sometimes several miles in width, evidently formed in flowing water, but of too high a level to have been formed by the present river, and being probably due to ancient glacial rivers.

20 d. *Yellow Loam*. The yellow, brown, or reddish loam forms the surface and furnishes the soils of the greater portion of the State of Mississippi, and is the source of its wealth as a great cotton-growing State. Professor Hilgard thinks it was an independent aqueous deposit posterior to the Bluff and Orange Sand, and anterior to the alluvial formations of the present epoch. Its prevalent character is that of a yellow clay or loam, without any definite structure or cleavage, variously tinged with iron, and it forms the best upland soils and sub-soils of the State, averaging about three feet in thickness, and sometimes twenty feet.

20 c. *The Bluff, or Loess*, of Mississippi, or cane-hills belt, presents the same remarkably uniform features as in other States and in all parts of the world, as described in the introduction to this volume. It consists of a fine silt, almost too silicious to be called a loam, of a grayish or yellowish buff tint. A certain degree of firmness is imparted to the mass, caused as Professor Hilgard thinks, by rough, irregular concretions, varying in size from fine sand grains to the weight of several pounds, (Loess puppets), into which the fine material has been cemented by earthy carbonates. Hence, it is little subject to erosion, maintains itself readily in even vertical cuts, and valleys cut into it have steep slopes, at times almost vertical walls.* Its thickness is sometimes as much as seventy feet, but it shows only obscure marks of stratification. Its fossils are terrestrial snails and quadrupeds.

20 b. *Port Hudson*. This is a formation consisting, in its landward portion chiefly of paludal, mostly dark-tinted and well stratified calcareous clays, often overlaid by brownish ill stratified loams, which intervene between it and the Loess proper. Its chief fossils are a fresh water and land fauna, among many vegetable remains, including cypress stumps. To seaward the beds become more brackish and finally of purely marine character. It underlies the Mississippi alluvium at least as far as Memphis, rises into "Crowley's Ridge," in Arkansas and Southeast Missouri, and also underlies the Red River alluvium to Shreveport. It is most widely developed in Louisiana.

20 a. *The Orange Sand, or stratified drift*, is an important formation. It covers nearly the whole State of Mississippi, except the alluvial bottoms of the river, being, however, itself often covered by the later formations above described. It forms the main body of most of the ridges of the State, and its great extent their surface. It gives character to the surface conformation, which, contrary to the popular impression, is generally hilly back from the river, though nowhere mountainous. All the sandy hills seen from the railroad, from 30 to 120 feet high, few of them as high as 400 feet, which are conspicuous features in the landscape, are due to the Orange Sand formation, out of which the hills have been formed by denudation of the valleys and lower ground. The sand of which it is chiefly composed.

*In *Science*, for August, 1884, I maintained that the steep slopes of the Loess were owing to its laminated structure, like the Genesee, and other shales. J. M.

Chicago, St. Louis & New Orleans Railroad.			Mississippi & Tennessee Railroad.		
Ms.	Illinois Central Line.	Alt.	Ms.		Alt.
0	New Orleans, La.	16	0	Grenada.	{ 20 c. Alluvial, 212 19 a. LaGrange.
48	Ponchatoula.		22	Oakland.	{ 20 b. Yellow Loam, 19 a. LaGrange.
78	Tangiphoa.		41	Bateville.	{ 20 b. Yellow Loam, 19 a. LaGrange.
88	Osyka.	{ 20 a. Orange Sand. 19 f. Grand Gulf.	50	Sardis.	{ 20 c. Loess, 19 a. LaGrange.
98	Magnolia.	" 93	63	Senatobia.	{ 20 c. Loess, 19 a. LaGrange.
108	Summit.	"	88	Hernando.	{ 20 c. Loess, 19 a. LaGrange.
118	Bogue Chitto.	"	100	Memphis.	" 215
128	Brookhaven.	"	Natches, Jackson & Columbus Railroad.		
189	Beauregard.	"	0	Natches.	{ 20 c. Loess, 19 f. Grand Gulf.
149	Hazlehurst.	"	26	Fayette.	{ 20 d. Yellow Loam, 19 f. Grand Gulf.
158	Crystal Springs.	20 d. Yellow Loam.	48	Martin.	"
167	Terry.	{ 20 d. Yellow Loam, 20 c. Alluvial.	78	Oakley.	"
174	Byram.	{ 19. Eocene and 20 c. Alluvial.	100	Jackson.	"
183	Jackson.	{ 20 d. Yellow Loam, 19 d. Jackson.	Mobile & Ohio Railroad.		
195	Madison.	"	63	State Line.	19. Later Tertiary.
206	Canton.	"	71	Buckatunna.	" 150
220	Vaughan's.	{ 20 c. Alluvial and 19 d. Jackson.	82	Waynesboro.	{ 20 d. Yellow Loam, 19 e. Vicksburg. 191
234	Goodman.	{ 20 c. Alluvial and 19 c. Claiborne.	96	Shubuta.	{ 20 d. Yellow Loam, 18 d. Ripley Gp. 197
242	Durant.	"	109	Quitman.	{ 20 d. Yellow Loam, 19 c. Claiborne. 231
251	West's.	{ 20 c. Alluvial and 19 b. Burstone.	120	Enterprise.	{ 20 c. Alluvial, 19 b. Burstone. 248
262	Vaiden.	{ 20 d. Yellow Loam, 19 d. Burstone.	135	Meridian.	{ 20 c. Alluvial, 19 b. Burstone. 336
271	Winona.	"	147	Lockhart.	19 b. Burstone. 360
283	Duck Hill.	{ 20 d. Yellow Loam, 19 a. LaGrange.	164	Narkeeta.	" 183
295	Grenada.	{ 20 c. Alluvial and 19 a. LaGrange. 213	176	Scoba.	{ 20 c. Alluvial, 18 c. Rotten Lime s.
310	Coffeeville.	{ 20 d. Yellow Loam, 19 a. LaGrange.	188	Shuqulak.	{ 20 d. Yellow Loam, 18 c. Rotten l. s. 221
328	Water Valley.	{ 20 c. Alluvial and 19 a. LaGrange.	198	Macon.	" 185
333	Taylor's.	"	211	Crawford.	" 216
340	Oxford.	{ 20 c. Alluvial, 20 a. Orange Sand. 19 a. LaGrange.	219	Artesia.	" 244
357	Abbeville.	"	232	West Point.	" 248
369	Holly Springs.	{ 20 d. Yellow Loam, 19 a. LaGrange.	241	Muldon.	" 304
378	Hudsonville.	{ 20 c. Alluvial and 19 a. LaGrange.	254	Egypt.	" 306
382	Lamar.	{ 20 d. Yellow Loam, 19 a. LaGrange.	262	Okolona.	" 311
394	Grand Jun., Tenn.	" 575	275	Verona.	" 307
			287	Saltillo.	" 313
			297	Baldwyn.	" 379

posed is in color of an orange yellow, sometimes very deep and glaring, but more frequently it is a dull rust color; in some places of a delicate rose color, with frequently bright yellow tints, and there are some deposits of white sand. There are, of course, an endless variety of intermediate tints, and sometimes crimson, purple and almost blue tints are observed. It also contains extensive gravel beds, usually forming belts of a general north and south direction; and irregular beds and bands of clayey materials are common where clayey formations underly. Its origin is not yet clearly ascertained, but it appears very much like a glacial river deposit, the materials being mainly derived from places south of the Ohio River on either side of the Mississippi. As the Mississippi must have been the great outlet of the vast glacial rivers of the age of ice, it is not to be supposed that it would leave us

Mobile & Ohio Railroad—			Cincinnati, New Orleans & Texas Pacific Railroad.		
Ms.	Continued.	Alt.	Ms.	Continued.	Alt.
809	Booneville.*	{ 20 d. Yellow Loam, 18 c. Rotten l. s. ⁵¹¹	59	Brandon.	{ 20 d. Yellow Loam, 19 f. Grand Gulf.
818	Rienzi.	{ 20 d. Yellow Lm. ⁴⁴¹ 18 b. Tombigbee Sd.			{ 19 e. Vicksburg. 20 d. Yellow Loam,
829	Corinth.	{ 20 d. Yellow Loam, 18 c. Rotten l. s. ⁴³⁴	70	Pelahatchie.	{ 19 a. Vicksburg.
E. Tennessee, Virginia & Georgia R. R. Memphis & Charleston Division.			79	Morton.	"
			90	Forrest.	"
79	Big Hill, Tenn.	{ 20 a. Orange Sand, 19 a. LaGrange.	100	Lake.	{ 20 d. Yellow Loam, 19 c. Claiborne.
84	Chewalla.	18 c. Rotten l. s. ⁴⁰⁹	109	Newton.	"
93	Corinth.	{ 20 d. Yellow Loam, 18 c. Rotten l. s. ⁴³⁴	122	Chunky.	{ 20 d. Yellow Loam, 19 b. Burstone.
107	Burnsville.	{ 20 a. Orange Sand, 18 a. Eutaw. ⁴⁶³	140	Meridian.	{ 20 c. Alluvial, 19 b. Burstone. ³³⁶
115	Iuka, Ala.	{ 20 a. Orange Sd., ⁴⁵⁵ 13 a. Keokuk or St. L.	New Orleans & Northeastern Railroad.		
(See Alabama for this Railroad.)			0	Meridian.	19 b. Burstone. ³³⁶
Cincinnati, New Orleans & Texas Pacific Railroad. Vicksburg & Meridian Division.			17	Enterprise.	19 c. Claiborne. ³⁴³
0	Vicksburg.	{ 20 c. Loess, 19 e. Vicksburg. ³⁰⁸	30	Barnet.	19 f. Grand Gulf ³⁰⁶
10	Bovina.	"	47	Sandersville.	"
18	Edwards.	"	64	Ellisville.	" ²²⁹
27	Bolton.	"	85	Hattiesburg.	" ¹⁴⁴
85	Clinton.	{ 20 d. Yellow Loam, 19 d. Jackson.	101	Purvis.	" ²⁶⁰
45	Jackson.	"	181	Derby.	" ¹⁶⁸
			147	Mitchell.	" ⁶⁹
			160	Pearl River	"
			167	Slidel, La.	{ 20 c. Loess, ⁸ 20 b. Port Hudson.
			191	Lake Shore.	"
			196	New Orleans	" ¹⁶

* Booneville, highest railroad point in the State.

traces of that period behind in some of the States on its borders. There is no doubt the deposition of the orange sand took place in flowing water, whose current had a general direction from north to south. This formation is 40 to 60 feet thick; 100 feet is not unusual, and even 200 feet. It contains the fossils of the underlying formations, but none of its own. The materials are non-calcareous and peroxidized throughout; highly ferruginous, and in part silicious sandstones form limited deposits, very frequently capping hills and ridges which have thus been preserved from erosion, profoundly influencing the surface conformation.

19. Later Tertiary.

19 f. *The Grand Gulf*. The highest Tertiary formation appearing on the surface of the State is the Grand Gulf group of blue, green and white, compact clays, and mostly soft whitish sandstones overlying the same. No fossils save a few leaves and small lignite beds have been found in it, although it occupies, in the southern part of the state, the large area covered by the long leaved pine. It is supposed to be of Miocene age.

19. Tertiary.

19 e. *Vicksburg* Miocene, the highest of the marine tertiary formations, occupies a narrow belt of nearly uniform width, extending across the State to the Tombigbee River in Alabama, and it contains a valuable crystalline limestone, associated, however, with blue and white marls and important beds of lignite, but the chief material is a soft white limestone.

19 d. *Jackson*. The territory of this group is characterized by the occurrence of the black prairie soil on its surface, and also of bald prairies, both very similar to those of the Rotten Limestone region. The material is either a soft yellowish limestone or indurated marl or a soft gray or yellowish calcareous clay, in which the large bones of the Zeuglodon are found.

19 c. *Claiborne*. This group of blue and white calcareous marls occupies but a small area in the state, its fossils are poorly preserved, and it imparts no obvious features to the surface of the country underlain by it.

19 b. *Burstone*. ("Silicious Claiborne," of Hilgard's Mississippi report). This group forms a wide and to northward ill-defined belt, northward of the Claiborne and Jackson area. Its materials are mostly soft yellowish or whitish sandstones and claystones, alternating with dark-tinted lignite-gypsaceous clays and sands; sometimes unconsolidated fossiliferous sands and silicious sandstones of the "burstone" character; also, highly ferruginous clays. Northward it passes insensibly into

Louisville & Nashville Railroad.			Louisville, New Orleans & Texas R. R.—		
Ms.	New Orleans & Mobile Division.	Alt.	Ms.	Continued.	Alt.
0	New Orleans.	16	245	Redwood.	{ 20 d. Alluvium over
52	Bay St. Louis, Miss.	24			20 b. Port Hudson.
59	Pass Christian.	10	257	Halpin.	"
71	Mississippi City.	10	271	Cary.	"
82	Ocean Springs.	28	278	Rolling Fork.	"
101	Scranton.	"	284	Anguilla.	"
141	Mobile.	6	288	Nitta Yama.	"
			306	Arcola.	"
			316	Leland.	"
			331	Nicholson.	"
			342	Coleman.	"
			363	Duncan.	"
			370	Bobo.	"
			378	Clarksdale.	" 87
			398	Lula.	"
			415	Tunica.	"
			426	Robinsonville.	"
			440	Walls.	"
			442	Lakeview.	{ 20 c. Loess over 20 a.
					Orange Sand and
					19 a. Eocene.
			455	Memphis.	" 127
Louisville, New Orleans & Texas R. R. Baton Rouge to Memphis.			Grand Gulf & Port Gibson Railroad.		
89	Baton Rouge.	{ 20 c. Loess over 20 b. Port Huron.	.....	Grand Gulf.	{ 20 c. Loess,
108	Slaughter.	"			{ 19 f. Grand Gulf.
118	Ethel.	"	.....	Port Gibson.	"
122	Wilson.	{ 20 a. Orange Ld. over 19 b. Port Hudson.			
135	Centreville.	"			
144	Gloster City.	"			
162	Day's.	"			
160	Knoxville.	"			
175	Hamburg.	"			
186	Harriston.	"			
193	Hays.	20 c. Loess.			
206	Port Gibson.	"			
218	Allens.	"			
222	Yokena.	"			
227	Warrenton.	" over 19 Eocene.			
235	Vicksburg.	" " 308			

19 a. *La Grange or Lignite* ("Northern Lignite" of Hilgard), which underlies all of the northern part of the state outside of the Cretaceous area, itself mostly covered by the Orange Sand. It consists of mostly dark-tinted shaly clays, interstratified with gray sands and lignite beds of some economic importance; shows a few marine outliers showing near relation to the Burstone, or more probably to the "Woods Bluff" beds of Alabama, the base of the Eocene Tertiary.

18. Cretaceous.

18 d. *Ripley Group* is composed of hard crystalline limestone, the highest strata and bluish micaceous marls more or less sandy below. The country suddenly becomes hilly and broken as you enter this formation. It is a hard, sandy limestone, with strata of blue shale marl between, and one of heavy gray calcareous clay on top.

18 c. *The Rotten Limestone* is an important formation 700 to 1,000 feet thick in the southwest, and thinning down in the northeast to 70 to 100 feet at the Tennessee line. The material is of great uniformity, a soft, chalky rock of a white or pale bluish tint, with a very little sand. When the rotten limestone appears on the surface it appears white or yellowish white, and preserves the same tint from 2 to 18 feet deep. Below that it is often bluish gray, which, when wet, looks quite dark. These white clay marls or soft limestone form a level or gently undulating surface with a heavy calcareous soil in the Prairie Region proper, and comprises some of the best land in the State.

18 b. *Tombigbee sand* has as its prevalent material a fine grained micaceous sand, usually of a greenish tint, but not unfrequently gray, bluish, black, yellow, and sometimes even orange red. The region is hilly and sandy and the soil generally inferior.

18 a. *Eutaw*. The territory occupied by this formation offers no striking characteristics in Mississippi, by far the larger portion of it being covered thickly by the Orange Sand. It consists of unconsolidated sands and dark-tinted clays.

14. The Sub-Carboniferous occupies a very small territory in the northeastern section of the State adjoining Alabama, and its geological relations can hardly be satisfactorily studied in Mississippi.

The Cretaceous and Tertiary formations of Mississippi are rich in fossils and afford favorite localities for the paleontologist. The geology of Mississippi may become important in the study of the vast, almost unknown region between the Mississippi River and the Sierra Nevada, where the same formations seem to prevail. In this connection see Mr. Loughridge's notes on the Indian Territory.

The foregoing descriptions of the sub-divisions of the Cretaceous, Tertiary and Quaternary apply to these formations in the adjoining States of Tennessee, Alabama and Louisiana. J. M.

Louisville, New Orleans & Texas R. R.			Galveston, Harrisburg & San Antonio Railroad- Continued.		
Ms.		Alt.	Ms.		Alt.
0	New Orleans.	20 d. Alluvium.	246	Sabine.	20 d. Alluvium.
5	Sauve.	"	256	Orange.	"
10	Kenner.	"	Missouri Pacific Railroad.		
23	Sarpy's.	"	(New Orleans to Marshall.)		
34	St. Peter's.	"	0	New Orleans.	20 d. Alluvium.
40	Mount Airy.	"	3	Harvey's Canal.	"
56	Whitehall.	"	19	Davis.	"
71	Southwood.	"	39	Johnson.	"
76	St. Gabriel.	"	54	Forstall.	"
89	Baton Rouge.	{ 20 c. Loess over 20 b. Port Hudson.	64	Donaldsonville.	"
90	Baker.	"	85	Plaquemine.	"
108	Slaughter.	"	89	Baton Rouge Jun.	"
113	Kilbourne.	"	97	W. Baton Rouge.	"
Morgan's Louisiana & Texas R. R.			127	Ravenwood.	"
0	New Orleans.	20 d. Alluvium.	140	Goshen.	"
3	Gretna.	"	154	Morrows.	"
12	Jefferson.	"	172	Cheneyville.	"
24	Boutte.	"	188	Moreland.	"
40	Raceland.	"	210	Boyce.	19 f. Grand Gulf Mio.
52	Lafourche.	"	224	Chopin.	"
60	Thibodaux.	"	237	Prudhomme.	"
55	Terrebonne.	"	247	Provencal.	"
70	Houma.	"	260	Marthaville.	19 a. Eocene.
66	Tigerville.	"	270	Sodus.	"
73	Boeuf.	"	288	Mansfield.	"
80	Morgan City.	"	303	Gloster.	"
81	Berwick.	"	318	Reisor.	"
100	Franklin.	"	328	Shreveport.	20 d. Alluvium.
113	Jeannerette.	20 b. Port Hudson.	343	Greenwood.	19 a. Eocene.
125	New Iberia.	"	352	Jonesville.	"
144	Lafayette.	"	360	Scottsville.	"
157	Grand Coteau.	"	368	Marshall.	"
166	Opelousas.	"	Cincinnati, New Orleans & Texas Pac. R. R.		
172	Washington.	"	(Vicksburg to Shreveport.)		
179	Garland.	20 d. Alluvium.	0	Vicksburg.	19 a. Eocene.
186	Whiteville.	"	0	Delta.	20 d. Alluvium.
195	Eola.	"	7	Mounds.	"
204	Cheneyville.	"	11	California.	"
215	Lamourie.	"	18	Tallulah.	"
228	Alexandria.	{ 20 d. Alluvium over 20 b. Pt. Hud's & 19 f. G'd Gulf Miocene.	25	Quebec.	"
Galveston, Harrisburg & San Antonio R. R.			32	Waverly.	"
(New Orleans to Orange.)			36	Delhi.	20 b. Port Hudson.
0	New Orleans.	20 d. Alluvium.	41	Carpenter's.	"
.....	Algiers.	"	48	Bee Bayou.	20 d. Alluvium.
55	Terrebonne.	"	52	Rayville.	"
80	Morgan City.	"	65	Gordon.	"
101	Franklin.	"	73	Monroe.	"
125	New Iberia.	20 b. Port Hudson.	82	Cheniere.	"
144	LaFayette.	"	87	Forks ville.	19 a. Eocene.
172	Estherwood.	"	89	Calhoun.	"
184	Jennings.	"	93	Averitt.	"
206	Pine Grove.	"	97	Choudrant.	"
228	Sulphur Mine.	{ 20 b. Pt. Hudson over 19 a. & 18 Creta.	105	Ruston.	"
235	Edgerly.	"	110	Allengreene.	"
			114	Simsboro.	"
			122	New Arcadia.	"
			144	Minden Junction.	"
			157	Haughton.	"
			170	Shreveport.	20 d. Alluvium.

Florida¹

General Note on the Geology of Florida.

The first intimation given to the scientific world of the true geology of Florida was by Dr. Eugene A. Smith in his report upon the "Soils of the Cotton Region" in Vol. VI. of the U. S. Census of 1880. The western, northern and middle highland regions mostly occupied his attention. To him is due the discovery that the oldest rocks of the Peninsula are of the division of the Eocene, known in Alabama and Mississippi as the Vicksburg Formation. In 1885, the U. S. Geological Survey prosecuted some work in Florida, principally for the collection of Tertiary fossils, and the observations there made, so far as published, (see Article in "The American Journal of Science," October, 1888, by L. C. Johnson,) show that the Eocene Axis is quite narrow, and not manifest by outcrops further south than Sumter County; by some of its effects it is traceable to Polk County. It is the basis of the "Interior Basin." The next and the most extensive development was called the "Waldo," from the place where the most abundant and decisive fossils were found. This has proved to be Miocene. Most of the phosphatic rocks belong to it. It is also the basis of the Lake region and of the "High Hummocks." It reaches the "Trail Ridge" and highlands of the eastern slope, and occupies the western slope to the Gulf as far south as Tampa.

The greater part of the St. John's River country is Pliocene, with much that is even later. The Jacksonville Formation, exposed at the water works, has been assigned to the Pliocene; while the "coquina" of St. Augustine and the marls of Indian River belong, probably all of them, to Post Pliocene times. The phosphatic rocks of Black Creek and of Enterprise—perhaps on insufficient grounds—are supposed to belong to the Jacksonville Formation.

In 1887, Prof. Angelo Heilprin, in a "Report of a Visit to the Southwest of Florida" decided the formations at Tampa to be Miocene, south of that, as far as explored and definitely settled by fossils, Pliocene. The actual coast and coral reefs and islands must be later.

The underlying limestones in many sections of the state have been dissolved in an irregular and often fantastic manner, producing sink holes, underground channels and numerous ponds and lakes.

The soils on the immediate surface of the country consist mainly of such sands as would be left by a receding ocean. In some places these are drifted into dunes, such as the high "Trail Ridge" and its continuations east, and the lower sand dune hills westward, which overlook the Hummock region, and separate it from the "Interior Basin." Probably the clays and "red lands" generally are derived, by disintegration and leaching from Miocene rocks. The interior "High Hummocks" are Miocene, or a few to the north Eocene, and the "Low Hummock" of the coast Pliocene or later.

The elevations of the highest ridges seldom exceed two hundred feet, whilst the Interior Basin and highest of the hills of the western region are not often much over one hundred feet, while the lower part of the state, south of Polk County, has an average elevation of only about thirty to forty feet above low tide.

Louisville and Nashville Railroad.			Florida Central and Peninsular.		
Ms.	Pensacola Railroad.	Alt.	Ms.	Florida Central and Western.	Alt.
0	Flomaton.	19 a. Eocene. (?)	0	Chattahoochee R.	19 a. Eocene. (?)
5	Bluff Springs.	20. Quat. & 19 a. Eoc. (?)	2	River June.	19 b. Miocene. (?)
12	McDavid.	"	3	Chattahoochee.	"
20	Molino.	"	20	Quincy.	"
28	Cantonment.	"	32	Midway.	19 a. Eocene.
38	Muscogee.	"	44	Tallahassee.	19 b. Miocene.
81	Gonzalez.	"		Ferrello.	"
44	Pensacola.	"	65	St. Marks.	"
Pensacola and Atlantic.			56	Chaires.	"
0	Pensacola.	Coast Qu. & 19 a. Eo. (?)	62	Lloyd's.	"
9	Escambia.	"	71	Drifton.	"
20	Milton.	"	75	Monticello.	"
60	Deer Land.	"	78	Ancillo.	19 a. Eocene.
67	Mossy Head.	19 b. Miocene. (?)	85	Greenville.	19 b. Miocene. (?)
80	De Funiak Sp'gs.	"	99	Madison.	"
91	Ponce de Leon.	"	106	Lees.	"
98	Westville.	"	114	Ellaville.	19 a. Eo. (Vicksburg.)
100	Caryville.	19 a. Eocene. (?)	127	Live Oak.	"
127	Cottondale.	"	138	Houstown.	"
186	Marianna.	19 a. Eo. (Vicksburg.)	138	Welborn.	19 b. Miocene. 250
147	Cypress.	"	142	Dowlings.	"
156	Sneads.	19 b. Miocene.	150	Lake City.	"
161	River June.	"	162	Olustee.	"

1. By Mr. Lawrence C. Johnson of Meridian, Miss., Assistant Geologist U. S. Geological Survey. The survey of the state was not completed by Mr. Johnson when he ceased work in that field, for which reason, or because the superficial deposits render the boundaries of the formations uncertain, he assigns many of the stations with a ?, denoting the probable formation.

Florida Central and Western Railway.			Jacksonville, St. Augustine and Halifax R.		
Ms.	Continued.	Alt.	Ms.	Continued.	Alt.
172 Sanderson.	19 b. Miocene. (?)		54 Olds.	(?)	
181 Darbyville.	"	(?)	56 Merrifield.	19 b. Miocene. (?)	
190 Baldwin.	19 c. Pliocene. (?)		59 Pattersonville.	"	
192 Clark's Junc.	"		69 Palatka.	"	
208 Wayercross Junc.	"		81 Velvinton.	"	
208 Jacksonville.	"		89 Dinner Isle.	19c Pliocene.	
0 Jacksonville.	"		97 Windemere.	"	
12 Hart's Road.	"		120 Ormond.	"	
23 Fernandina.	"	10	123 Holly Hill.	"	
34 Hart's Road Jc.	"	10	126 Daytona.	"	
41 Italia.	"		Florida Southern Railway.		
50 Callahan.	"	80	0 Palatka.	19 b. Miocene. (?)	
59 Dutton.	"	45	18 Interlaken.	"	
Brandy Branch.	"		40 Rochelle.	19 b. Miocene.	
60 Baldwin.	"	47	50 Gainesville.	"	185
Maxville.	"	57	49 Micanopy.	19 a. Eocene.	
88 Highland.	"	210	49 Boardman.	19 b. Miocene.	
89 Lawtey.	19 b. Miocene. (?)	140	57 Reddick.	"	
Temples.	19 b. Miocene.	150	72 Ocala.	"	
Starke.	"	150	88 Ocklawaha.	19 a. Eocene.	
108 Waldo.	"	150	East Lake.	19 b. Miocene.	
Fairbanks.	" [Vicksb'g.		96 Conant.	"	
122 Gainesville.	19 b. Mio. underl'd by	70	106 Leesburg.	"	
Arredondo.	19 a. Eocene.	70	Drage Junc.	"	
Archer.	"	70	135 Pemberton Fe'ry.	19 a. Eocene.	
Bronson.	19 b. Miocene.	27	146 Brooksville.	19 b. Miocene.	
Otter Creek.	"	19	106 Leesburg.	"	
Rosewood.	"	12	120 Ft. Mason.	"	
178 Cedar Key.	"	10	122 Eustis.	"	
108 Waldo.	"	150	126 Tavares.	"	
122 Hawthorne.	"	150	129 Lane Park.	"	
Lockloosa.	"	82	120 Ft. Mason.	"	
134 Citra.	"		124 Umatilla.	"	
Sparrs.	"	72	127 Altoona.	"	
Anthony.	"		129 Pittman.	"	
147 Silver Spring Jc.	19 a. Eocene.	89	145 Astor.	"	
151 Silver Spring.	"		135 Pemberton Fe'ry.	19 a. Eocene.	
153 Ocala.	19 b. Miocene.	100	179 Lakeland.	19 b. Miocene.	250
Lake Wier.	"		192 Bartow.	"	
Wildwood.	"		204 Ft. Meade.	"	
Panasoffkee.	"		241 Arcadia.	"	
Withlacoo'ee.	19 a. Eocene.		251 Ft. Ogden.	"	
190 Leesburg.	19 b. Miocene.		261 Cleveland.	"	
201 Tavares.	"		268 Punta Gorda.	"	
Green Cove Springs and Melrose.			Orange Belt Railway.		
Green Cove Spgs.	19 b. Miocene. (?)		0 St. Petersburg.	19 b. Miocene.	
Sharon.	"		15 Armour.	"	
Jacksonville, St. Augustine and Halifax R.			18 Clearwater.	" (?)	
0 Jacksonville.	19 c. Pliocene.		25 Yellow Bluff.	" (?)	
3 Phillips.	"		31 Tarpon Springs.	"	
16 Bayard.	"		51 Drexel.	"	
19 Clarkville.	"		64 San Antonio.	" (?)	
28 Sampson.	"		71 Blanton.	" (?)	
37 St. Augustine.	"		73 Lenard.	" (?)	
52 Tocol.	19 b. Miocene. (?)		76 Macon.	"	
45 Smith's.	"		86 Tarrytown.	"	
45 Middleton.	19 c. Pliocene.				

Orange Belt Railway.—Continued.			Savannah, Florida & Western Railway.		
Ms.		Alt.	Ms.	Gainesville Line.	Alt.
91	Cedar Hammock.	19 b. Miocene. (?)	180	Dupont, Ga.	19 b. Miocene.
101	Sheridan.	"	163	Jasper.	"
106	Clermont.	"	171	Suwannee.	19 a. Eocene.
108	Minneola.	"	179	Live Oak.	"
115	Killarney.	"	190	McAlpin.	"
117	Oakland.	"	203	New Branford.	"
128	Lakeville.	"	216	Ft. White.	19 b. Miocene.
133	Forest City.	"	249	Gainesville.	"
138	Groveland.	"	Pemberton Ferry Branch.		
144	Paola.	"	0	Pemberton Fy.	19 a. Eocene. (?)
145	Sylvan Lake.	"	23	Richland.	19 b. Miocene.
148	Monroe.	"	43	Lakeland.	"
Jacksonville, Tampa and Key West.			56	Bartow.	"
0	Jacksonville.	19 c. Pliocene.	Sanford and Indian River Railroad.		
4	Edgewood.	"	0	Sanford.	19 b. Miocene.
10	Black Point.	" (?)	18	Lake Charm.	"
14	Orange Park.	"	0	Lake City.	"
20	Black Creek.	"	19	Lake City Jc.	"
28	Magnolia.	"	22	Ft. White.	"
29	Green Cove Sp's.	19 b. Miocene. (?)	Jacksonville Division.		
34	Walkill.	"	211	Waycross, Ga.	19 b. Miocene. (?)
41	W. Tocol.	"	246	Folkston, Ga.	19 c. Pliocene. (?)
46	Bostwick.	"	251	Borlogne.	"
56	Palatka.	"	257	Hilliard.	"
63	Buffalo Bluff.	"	267	Callahan.	"
64	Satsuma.	19 c. Pliocene. (?)	280	Jacksonville.	"
67	Sisco.	"	Jacksonville and Atlantic.		
72	Como.	"	0	Jacksonville.	19 c. Pliocene.
78	Denver.	"	17	Pablo Beach.	20. Quaternary.
84	Seville.	"	Atlantic and Western.		
92	Eldridge.	"	0	Blue Spring.	19 b. Miocene. (?)
94	Barbersville.	"	1	Orange City Jc.	"
108	Deland Jc.	"	3	Orange City.	19. c. Pliocene (?)
113	Orange City Jc.	"	25	Glencoe.	"
119	Enterprise Jc.	"	28	New Smyrna.	19 c. Plio. or 20. Qu
125	Sanford.	"	Western Railway of Florida.		
0	Enterprise Jc.	"	0	Green Cove Sps.	19 c. Pliocene. (?)
4	Enterprise.	19 b. Miocene. (?)	10	Sharon.	"
11	Osteen.	"	15	Belmore City.	19 b. Miocene.
24	Maytown.	19 c. Pliocene. (?)	Silver Springs, Ocala and Gulf.		
40	Titusville.	"	0	Ocala.	19 b. Miocene.
0	Sanford.	19 b. Miocene.	25	Dumelton.	"
6	Paola.	"	48	Homosassa.	" (?)
18	Sorrento.	"	Tavares, Apopka and Gulf.		
29	Tavares.	"	0	Tavares.	19 b. Miocene.
South Florida Railroad.			23	Waits Jc.	"
0	Sanford.	19 b. Miocene.	29	Clermont.	"
10	Longwood.	"	Jacksonville, Mayport and Pablo.		
22	Orlando.	"	0	Jacksonville.	19 c. Pliocene.
34	McKinnow.	"	8	Cohasset.	"
40	Kissimmee.	19 c. Pliocene. (?)	16	Burnside Beach.	20. Quaternary.
57	Davenport.	19 b. Miocene. (?)	20	Mayport.	"
68	Bartow Jc.	"			
72	Auburn Dale.	"			
83	Lakeland.	"			
115	Tampa.	"			
124	Port Tampa.	"			

Kentucky.¹GEOLOGICAL FORMATIONS FOUND IN KENTUCKY.²

20 d. Alluvium.	10 c. Black Shale.
20 c. Bluff or Loess.	9 c. Corniferous.
20 b. Port Hudson.	
20 a. Gravel (equivalent of Orange Sand of Tennessee).	5 c. Niagara.
	5 b. Clinton.
19. Tertiary, Lower Eocene.	
18. Cretaceous, Ripley.	
14. c. Upper Coal Measures.	4 c. ³ Upper.
14 b. Lower Coal Measures.	4 c. ² Middle.
14 a. Millstone grit.	4 c. ¹ Lower.
13 c. Chester.	4 a. Trenton.
13 b. Upper Sub-Carboniferous.	
13 a. Lower Sub-Carboniferous.	3 a. Chazy.

1. By John R. Proctor, Director of the Kentucky Geological Survey.
2. The geological survey is in progress, and the formations of the State not fully determined.
3. *Louisville*, the metropolis of Kentucky, very interesting to the geologist. At this point the Ohio River falls 23 feet over ledge of Corniferous and Niagara limestone. At low water the limestone is exposed over a wide area, and discloses the finest collecting ground for corals in this country. Several large collections of Devonian and Upper Silurian corals are owned in Louisville.
5. *Cincinnati*. As to ancient glacial dam at Cincinnati, see Note 62 Ohio, 76 Indiana, 62 West Virginia.
6. *Bagdad*. About six miles to the south of this place can be seen an isolated hill capped with Niagara limestone. This hill is about 1,250 feet above the level of the sea, and the Niagara is found here at a greater elevation than elsewhere in the State.
7. *Benson*. In descending the hill to Benson the road passes through the Middle Hudson.
8. *Frankfort*. Hills around Trenton, the Birdseye limestone reaches up the bank of the Kentucky River as high as the tunnel. Good collecting ground for Trenton fossils.
9. *Springs Station*. Near here are some of the most celebrated stock farms. They are on the (4 c.) Lower Hudson River formations.
10. *Payne's*. Stage from here to Georgetown passes through some of the most beautiful lands of the Blue Grass region.
11. *Colesburg*. This place is at the base of Muldrow's Hill, the road ascends this hill between this point and Elizabethtown. This hill extends around central Kentucky, from the mouth of Salt River on the west to Lewis County on the east, retaining for its entire length the same geological formations, viz.: Black shales (10 c.) at base, and Waverly sandstones and shales (13 a.), and Upper Sub-Carboniferous limestone (13 b.). In Madison County the hill attains its greatest height (1,650 feet above sea), where it is capped with the Carboniferous conglomerate, having a workable bed of sub-conglomerate coal. The Chester (13 c.) is also present in this portion of the hill. It is there known as Big Hill. Muldrow's hill represents the retreating escarpment of the rocks formerly extending over central Kentucky. Siliceous remains of these Paleozoic rocks have been found scattered over the uplands of central Kentucky, and have been by some erroneously classed as glacial drift.
12. *Elizabethtown*. County town of Hardin County. St. Louis Group of Sub-Carboniferous limestone.
13. *Mumfordsville*. County town of Hart County. The road crosses Green River at this point. The high hill on south side of river is capped with Chester sandstone, as are also the hills to the left of road between Cave City and Glasgow Junction.
14. *Glasgow Junction*. Branch road to Glasgow. This is the nearest station to Mammoth Cave. Several beautiful caverns in this neighborhood. All of these caverns are in the St. Louis limestone, and some of them reach up to the Chester sandstone which caps the hills seen to the north of the road from this point to Bowling Green, 41 miles, all the drainage being subterranean.
15. *Bowling Green*. County seat of Warren County. Road crosses the Big Barren River at this point. Boats run from here to Evansville, on the Ohio River.
16. *Franklin*. County seat of Simpson County. The division between 13 a. and 13 b. is not far from this place. Geology of county not yet studied in detail.
17. *Hopkinsville*. County Seat of Christian County. Surrounded with very fertile lands. This county produces more wheat and tobacco than any county in the State. The best lands in this and adjoining counties are not excelled by any in America. The superior body of land beginning near Smith's Grove, in Warren County, and comprising a portion of Warren, Simpson, Logan, Todd, Christian, Trigg, Caldwell and Lyon, is the largest body of all good land with which the writer has any acquaintance. The Western State Asylum for the Insane is located near Hopkinsville.

Louisville & Nashville Railroad. Ms. (Louisville, Cincinnati & Lexington Div.) Alt.			Louisville & Nashville Railroad. Ms. (Main Line.) Alt.		
0	Louisville. ³	{ 10 c. Black Slate, 9 c. Corniferous, 5 c. Niagara, 4. Trenton.	0	Louisville. ³	{ 20 b. Loess, 9 c. Corniferous, 5 a. Niagara. 428
10	Ormsby's.	"	8	S. Louisville.	10 c. Black Shale.
12	Anchorage.	9 c. Corniferous.	18	Shepherdsville.	{ 9 c. Corniferous. 424 5 c. Niagara,
16	Pewee Valley.	5 c. Niagara.	22	Bardstown Junc.	5 c. Niagara. 415
27	La Grange.	5 b. Clinton. 860	30	Lebanon Junc.	10 c. Black Shale. 426
33	Pendleton.	4 c. ³ Up. Hudson. 888	34	Colesburg. ¹¹	13 a. L. Sub-Carb. 423
36	Sulphur.	" 691	42	Elizabethtown. ¹²	13 b. Up. Sub-Car. 631
41	Campbellsburg.	" 904	50	Glennale.	" 628
54	English.	" 486	55	Sonora.	" 697
56	Worthville.	" 505	78	Munfordsville. ¹³	" 568
65	Sparta.	" 550	81	Horse Cave.	" 601
70	Glencoe.	" 593	85	Cave City.	" 611
75	Elliston.	" 870	91	Glasgow Junc. ¹⁴	" 621
84	Verona.	" 927	96	Rocky Hill.	" 594
89	Walton.	" 587	100	Smith's Grove.	" 606
98	Independence.	" 523	114	Bowling Green. ¹⁵	" 466
106	Wilder's.	" 587	118	Memphis Junc.	" 581
109	S. Covington.	" 523	125	Woodburn.	" 608
109	Newport.	" 523	134	Franklin. ¹⁶	" 639
110	Cincinnati. ⁵	"	141	Mitchellville.	" 748
(Lexington Division.)			146	Fountainhead.	" 778
27	La Grange.	5 b. Clinton. 880	159	Gallatin.	4 c. Hudson River. 494
32	Jericho.	4 c. ³ Upper Hudson.	.....	Edgefield Junc.	" 414
35	Smithfield.	"	185	Nashville.	4 a. Tren., 20 b. Loess. 430
40	Eminence.	"	(Memphis Division.)		
44	Pleasantville.	"	118	Memphis Junc.	13 b. Up. Sub-Carb. 531
49	Christianburg.	"	123	Rockfield.	" 566
52	Bagdad. ⁶	"	132	Auburn.	" 603
59	Benson. ⁷	4 c. ¹ Lower Hudson.	143	Russellville.	" 533
65	Frankfort. ⁸	4 a. Trenton.	148	Cave Spring.	" 586
76	Spring Station. ⁹	4 c. ¹ Hudson River.	157	Allensville.	" 552
79	Midway.	"	164	Guthrie.	" 525
83	Payne's. ¹⁰	"	(Nashville & St. Louis Division.)		
87	Yamallton.	"	0	Nashville.	13 b. Up. Sub-Carbon.
94	Lexington.	" 946	47	Guthrie.	" 523
(Shelbyville Division.)			.....	Trenton.	"
12	Anchorage.	9 c. Corniferous.	.....	Pembroke.	"
17	Eastwood.	5 c. Niagara.	71	Hopkinsville. ¹⁷	" 550
23	Simpsonville.	4 c. ³ Upper Hudson.	84	Crofton.	"
30	Shelbyville.	"	95	Nortonville. ¹⁸	14 c. Coal Meas. 410
38	Finchville.	"	102	Earlington. ¹⁹	" 370
42	Normandy.	"	107	Madisonville.	" 435
47	Taylorsville.	"	118	Slaughter's.	"
57	Bloomfield.	"	145	Henderson. ²⁰	{ 20 b. Loess. 403 14 c. Coal Meas.

18. Nortonville. Junction Chesapeake, Ohio & Southwestern Railway fault here. Coal No. 9 west, and coals No. 11 and 12 east of station.

19. Earlington. St. Bernard Coal Co., one of the largest mines in the State.

20. Henderson. Bottom lands Loess (20 b.) resting on Carboniferous.

21. New Hope. Prosperous city, large tobacco market, fine bridge over Ohio River; about 14 miles from New Hope. At Coal Hollow distillery, is a fine collecting ground of the fossils *Beatricea Columnaria Alveolata*.

22. Lebanon. County town of Marion County. Junction of Cumberland & Ohio Railroad, southern division. The streams around Lebanon cut down to Upper Hudson rocks. Hills seen to south, continuation of Muldrow's Hill (see Note 11). Fine localities for collecting Sub-Carboniferous fossils in the hills a few miles south from Lebanon.

23. Riley's. Fine collecting grounds near Riley's Station of Corniferous fossils.

Louisville & Nashville Railroad—Con.			Louisville & Nashville Railroad—Con.		
Ms.	(Knoxville Division.)	Alt.	Ms.	(Knoxville Division.)	Alt.
0	Louisville. ⁸	(As before).	140	Livingston. ²⁶	14 a. Millstone Grit ⁸⁵⁵
80	Lebanon Juno.	10 c. Black Shale. ⁴³⁸	152	East Bernstadt. ²⁷	14 b. Low. Coal Meas.
85	Boston.	" ⁴³¹	155	Pittsburg. ²⁸	"
45	New Haven.	{ 10 c. Black Shale,	157	London.	"
		{ 9 c. Corniferous,	165	Lily.	"
		{ 5 c. Niagara. ⁴⁴¹	174	Woodbine.	"
50	New Hope. ²¹	{ 5 c. Niagara, ⁴⁴⁴	181	Rockhold.	"
		{ 4 c. Upper Hudson.	189	Williamsburg. ²⁹	"
57	Loretto.	10 c. Black Shale.	201	Jellico. ³⁰	"
62	St. Mary's.	5 c. Niagara. ⁷³⁸	Chesapeake & Ohio Railroad. (Lexington Division.)		
67	Lebanon. ²²	{ 9 c. Corniferous ⁷⁵⁴			
		{ 10 c. Black Shale.	0	Lexington.	4 a. Trenton. ⁹⁴⁶
76	Riley's. ²³	{ 9 c. Corniferous,	11	Pine Grove.	" ⁹⁶⁰
		{ 10 c. Black Shale,	18	Winchester.	{ 4 c. ¹ Lower Hudson
85	Mitchellsburg.	{ 5 c. Niagara.			{ River. ⁹⁶⁴
		{ 10 c. Black Shale,	.....	Hedges Station.	4 c. ² Middle Hud. ⁹⁷⁶
89	Parksville. ²⁴	{ 9 c. Corniferous,	38	Mt. Sterling. ³¹	4 c. ³ Upper Hud. ⁹⁸⁴
		{ 5 c. Niagara. ¹⁰³²	49	Olympia. ³²	5 c. Niagara. ⁷⁵¹
95	Junction City.	10 c. Black Shale. ⁹⁹⁷	57	Farmer. ³³	10 c. Black Shale. ⁶⁶⁸
96	Shelby City.	" ⁹⁹⁷	65	Morehead.	13 a. Waverly. ⁷¹²
		{ 9 c. Corniferous.	83	Olive Hill. ³⁴	" ⁷⁵²
104	Stanford.	4 c. Upper Hudson. ⁸⁴⁴	99	E. K. Junction. ³⁵	14 b. Coal Meas. ⁶¹⁸
105	Rowland.	"	102	Denton.	" ⁶⁰¹
		{ 10 c. Black Shale,	109	Rush.	" ⁶⁴⁷
115	Crab Orchard. ²⁵	{ 9 c. Corniferous,	116	Mean's.	" ⁶²²
		{ 5 c. Niagara. ⁹²⁹	122	Ashland. ³⁶	{ 20 b. Loess, ⁵⁴⁴
129	Mt. Vernon.	13 b. U. Sub-Carb. ¹¹¹⁸			{ 14 b. Coal Measure. ⁵⁴⁴
		" ⁹⁸⁴	128	Catlettsburg. ³⁷	" ⁵⁴⁴
135	Pine Hill.	{ Hills capped with	138	Huntington.	" ⁵⁶⁶
		{ 14 a. Millstone Grit.			

24. *Parkville.* Hills to the south capped with St. Louis limestone; fine collecting ground for *Lithrostrotion Canadensis*. A section may be obtained in a distance of four miles on a north and south line from the Trenton limestone to the top of the Sub-Carboniferous. The hills have waste of the Carboniferous conglomerate on top.

25. *Crab Orchard.* Springs of same name located near here. Caudi Galli found beneath the Corniferous near springs.

26. *Livingston.* Crossing of Rock Castle River. Coal mines in Lower or Sub-Conglomerate here. Fine section of St. Louis and Chester rocks on south side of river. Quarries of fine building stone. Hills on south capped with massive conglomerate sandstone.

27. *East Bernstadt.* Mines in the coal above the conglomerate, probably No. 1. The coal from these mines and from Pittsburg Station, a few miles south, takes high rank in the market, and the output is increasing rapidly. It is known as "Laurel Coal."

28. *Pittsburg.* Several extensive coal mines here.

29. *Williamsburg.* County town of Whitley County. Crossing of Cumberland River.

30. *Jellico.* State line. Extensive coal mines in lower measures near here. Coal of excellent quality. The great Pine Mountain fault can be seen a short distance southeast from this station.

31. *Mt. Sterling.* County town of Montgomery County. Junction of the Kentucky & South Atlantic Railway. The hills seen to the east are a continuation of Muldrow's Hill. (See Note 11.)

32. *Olympia.* Near here extensive deposit of iron ore now being mined. Ore supposed to be in Corniferous. Clinton iron ore is also found in Bath County.

33. *Farmer.* Crossing of Licking River.

34. *Olive Hill.* Very thick deposit of superior fire clay near this station; fine clay also near Enterprise. An excellent building stone is obtained from the Waverly sandstone along the line of the road in Rowan County.

35. *Eastern Kentucky Junction.* Crossing of the Eastern Kentucky Railway. The Mt. Savage furnace is one mile east from here, and fine veins of coals No. 3 and 7.

36. *Ashland.* Extensive iron manufactory. Junction of the Chatteroi Railway. Bottom lands Loess (20 b.) resting on Carboniferous.

37. *Catlettsburg.* County town of Boyd County. Confluence of the Big Sandy River with the Ohio River.

38. *West Point.* Crossing of Salt River. Road ascends Muldrow's Hill (see Note 11) after crossing river. Fine sections of Sub-Carboniferous rocks exposed.

39. *Grayson Springs.* Celebrated summer resort; good collecting ground for Chester fossils.

40. *Litchfield.* County town of Grayson County. Sandstone seen here; base of Chester Group; same as massive sandstone above St. Louis limestone at Mammoth Cave and elsewhere. A mile south of here thick deposit of marly shale, containing potash.

Chesapeake, Ohio & Southwestern R. R.			Cincinnati, New Orleans & Texas Pacific Railroad.		
Ms.		Alt.	Ms.		Alt.
0	Louisville. ⁸	{ 20 b. Loess, 488 10 c. Black Shale, 9 c. Corniferous.	0	Cincinnati. ⁵	4 c. Hudson River.
9	Pleasant Ridge.	{ 10 c. Black Shale, 18 a. L. Sub-Carb. ⁴⁴⁵	5	Kenton Heights.	" 845
21	West Point. ³³	{ 20 b. Loess, 410 10 c. Black Shale.	7	Erlanger. ⁴⁷	" 915
27	Muldraugh.	18 b. Up. Sub-Carb. ⁷³⁸	14	Richwood.	" 939
37	Vine Grove.	" 719	18	Walton.	" 927
47	Cecelia.	13 c. Chester. 688	21	Bracht.	" 904
52	Stephensburg.	13 b. Up. Sub-Carb. ⁶⁶²	25	Crittenden.	" 921
62	Big Clifty.	13 c. Chester. 738	28	Sherman.	" 939
67	Grayson Sp'gs. ³⁹	" 709	32	Dry Ridge.	" 964
72	Litchfield. ⁴⁰	" 710	35	Williamstown.	" 931
78	Milwood.	14 b. L. Coal Meas. 554	44	Blanchet.	" 961
84	Caneyville.	" 450	46	Corinth.	" 968
97	Horse Branch.	" 527	49	Hinton.	" 958
100	Rosine.	" 597	54	Sadieville.	" 872
109	Beaver Dam.	14 c. U. Coal Meas. ⁴⁹²	60	Roger's Gap.	" 921
118	Rockport. ⁴¹	" 485	63	Kinkaid.	" 877
127	Central City. ⁴²	" 587	67	Georgetown.	" 883
134	Greenville. ⁴³	" 477	71	Donerail.	" 897
147	White Plains.	" 492	76	Sandersville.	" 981
151	Nortonville.	" 509	79	Lexington.	4 a. Trenton. 975
157	St. Charles.	14 b. Low. Coal Meas.	85	Windom.	" 1034
165	Dawson.	13 b. Up. Sub-Carb. ⁶²⁴	87	Catnip Hill.	" 990
180	Princeton. ⁴⁴	" 487	91	Nicholasville.	" 960
192	Eddyville.	13 a. L. Sub-Carb. 487	96	Wilmore.	" 887
194	Kuttawa. ⁴⁵	{ 20 c. Alluvium, 494 13 a. Low. Sub-Carb.	100	High Bridge. ⁴⁶	" 777
209	Calvert City.	{ 20 c. Alluvium, bluff, gravel and loam. ⁴⁸⁴	106	Burgin.	" 902
226	Paducah. ⁴⁶	"	107	Harrodsburg Juno.	" 915
240	Boaz.	"	114	Danville.	" 970
244	Hickory.	"	118	Junction City	10 c. Black Shale. 997
250	Mayfield.	"	124	Moreland.	" & 5 c. Niag. ¹¹⁰¹
255	Pryor's.	"	129	McKinney. ⁴⁹	5 c. Niagara. 1023
259	Wingo.	"	136	King's Mount. ⁵⁰	{ 13 a. Waverly, 1189 10 c. Black Shale.
266	Water Valley.	"	139	Waynesburg.	13 b. St. Louis. 1230
271	Fulton.	" Bluff loam.	143	Eubanks.	" 1167
			148	Pulaski.	" 1185
			151	Science Hill.	" 1130
			152	Norwood.	" 1137
			158	Somerset.	" 882
			163	Cedar Grove.	" 851

41. *Rockport.* Crossing of Green River. Coal mined here, and at McHenry Station (Coal No. 9).

42. *Central City.* Extensive coal mines. Coals 11 and 12 near level of railway.

43. *Greenville.* County town of Muhlenburg County. Deposits of limonite iron ore in county, in Lower Coal Measures.

44. *Princeton.* County town of Caldwell County. Fine quarries in the oolite bed of St. Louis limestone near here.

45. *Kuttawa.* Near the base of St. Louis Group. Road crosses Cumberland river west of this station. Large deposits of limonite ore near here.

46. *Paducah.* County town of McCracken County. At this point extensive deposit known as the Paducah Gravel Beds, affording one of the best and cheapest road materials to be found in this country. This gravel (20 a.) is composed of waste from the degraded beds to the eastward, and is principally quartz pebbles from the Corniferous conglomerate, and angular fragments of chert from the Lower Sub-Carboniferous rocks, with coarse, angular sand all quite ferruginous. When properly put on streets or roads it soon cements, needs little after repairs, affording a smooth, hard road. It also affords a superior material for concrete.

47. *Erlanger.* Glacial deposits are found on the highlands, 560 feet above the river, both south and west of Greenwood (Erlanger). A noteworthy collection of Jasper conglomerate boulders from Lake Superior occurs on the road to Burlington, three miles west of Florence. G. F. W.

48. *High Bridge.* Crossing of Kentucky River. Bridge, 275 feet above water. Cliffs composed of Birdseye and Chazy limestones.

49. *McKinney.* The Upper Hudson is crossed between Moreland and McKinney's Station.

50. *King's Mountain.* The tunnel south of King's Mountain 4,000 feet long, is in the Waverly shales. King's Mountain is a continuation of Muldrow's Hill. (See Note No. 11.) The hills here are capped with the St. Louis limestone.

Cincinnati, New Orleans & Texas Pacific			Kentucky Central Railroad—Con.		
Ms.	Railroad—Con.	Alt.	Ms.	(Knoxville Division.)	Alt.
165	Burnside. ⁵¹	13 b. St. Louis.	770	0 Paris.	4 c. Hudson River.
167	Tatesville.	"	874	9 Austerlitz.	"
170	Sloan's Valley.	"	914	16 Winchester.	4 c. ¹ Lower Hudson.
176	Greenwood.	14 b. L. Cl. Meas.	1195	25 Riverside.	"
179	Cumberland Falls.	s. ⁵²	1245	38 Richmond.	4 c. ³ Upper Hudson.
182	Flat Rock.	"	1296	48 White's.	"
187	Whitley.	"	1340	51 Berea.	10 c. Black Shale.
194	Pine Knot.	"	1415	58 Conway.	13 a. Waverly.
198	State Line.	"	1345	65 Langford.	"
Chesapeake & Ohio Railroad.			72 Link's.	"	
(Kentucky Central Division.)			75 Livingston.	13 b. St. Louis.	
0	Covington.	4 c. Hudson River.	Kentucky Union Railway.		
14	Visalia.	"	0 K. U. Junction.	4 c. ² Middle Hud.	980
21	Morning View.	"	6 Kidvills.	5 c. Niagara.	950
24	Demossville.	"	9 Abbott's.	{ 10 c. Black Shale,	
28	Butler.	"	12 Wattersville.	{ 5 c. Niagara.	565
39	Falmouth.	"	14 Clay City.	10 c. Black Shale.	562
50	Boyd.	"		"	564
53	Berry.	"	Eastern Kentucky Railroad. ⁵³		
65	Cynthiana.	"	0 Riverton. ⁵⁴	14 b. Low. Coal Meas.	
72	Shawhan.	"	3 Three Miles.	"	
79	Paris.	"	5 Worthington. ⁵⁵	"	
86	Hutchinson.	"	6 Argillite. ⁵⁶	"	
89	Mair.	"	9 Laurel.	"	
99	Lexington.	4 a. Trenton.	10 McAllister.	"	
79	Paris.	4 c. ¹ L. Hudson R.	12 Hunnewell. ⁵⁷	"	
95	Winchester.	"	15 Denning's.	"	
106	Boone.	4 c. ³ Up. Hudson River	16 Hopewell. ⁵⁸	"	
118	Richmond.	4 c. ² Mid. Hud. R.	18 Anglin's.	"	
122	Argenta.	"	21 Pactolus. ⁵⁹	"	
133	Paint Lick.	4 c. ³ Up. Hudson R.	23 Grayson. ⁶⁰	"	
144	Lancaster.	"	26 Vincent's.	"	
151	Rowland.	"	28 Mt. Savage. ⁶¹	"	
Kentucky Central Railroad.			29 Reedville.	"	
(Northern Division.)			34 Willard. ⁶²	"	
.....	Lexington.	4 a. Trenton.	Chattahoochee Railway.		
.....	Muir.	4 c. Hudson River.	0 Ashland. ³⁶	14 b. Low. Coal Meas.	
79	Paris.	"	6 Catlettsburg. ³⁷	"	
88	Millersburg.	"	14 Lockwood's.	"	
95	Carlisle.	"	19 Rockville.	"	
109	Ewing.	"	26 Fuller's.	"	
113	Johnson.	"	31 Louisa.	"	
128	Maysville.	"	36 Walbridge.	"	
			40 Northrup.	"	
			46 Peach Orchard. ⁶³	"	
			50 Richardson.	"	

51. *Burnside.* Crossing of Cumberland River.

52. *Cumberland Falls.* A few miles from railway, perpendicular fall of Cumberland River of 63 feet, over the Carboniferous conglomerate. Beautiful scenery and excellent fishing.

53. This railroad runs through the heart of the Kentucky division of the Hanging Rock Iron Region. On the line of the road all of the coals are to be found, from No. 1 to No. 11, and most of the iron ores.

54. *Riverton.* No. 1 Coal near water level.

55. *Worthington.* No. 3 Coal in the hills, about 150 feet above grade of road.

Illinois Central Railroad.			Kentucky & South Atlantic R. R.		
Ms.	(New Orleans Division.)	Alt.	Ms.		Alt.
0	Cairo.	{	0	Mount Sterling. ³¹⁴	4 c. ³ Upper Hudson.
2	East Cairo.		6	Spencer.	"
6	Wickliffe. ⁴⁴		10	Johnson's.	"
16	Bardwell.		12	Pollard's.	"
22	Arlington.	{	14	Heges.	"
30	Clinton.		15	Chamber's.	5 c. Niagara.
44	Fulton.		19	Cornwall.	"
			21	Rothwell.	"
			23	Frenchburg Jc.	10 c. Black Shale.
Mobile & Ohio Railroad.			Evansville, Owensboro & Nashville R. R.		
0	Cairo.	{	0	Owensboro.	14. Carboniferous.
2	East Cairo.		7	Sutherland.	"
6	Wickliffe. ⁴⁴		15	Riley's.	"
18	Berkeley.		21	Livermore.	"
23	Columbus. ⁶³	{	27	Stroud's.	"
34	Moscow.		35	Owensboro Junc.	"
42	Jordon.				

56. *Argillite*. Near site of Old Argillite Furnace, probably the oldest furnace in the Hanging Rock Iron Region, erected in 1822. About three miles east of station is the Pennsylvania Furnace, and three miles west the Buffalo Furnace.

57. *Hunnswell*. Hunnswell Furnace located here; also the machine and repair shops of the railroad. Mines of No. 3 and No. 4 Coal, the latter known as the Hunnswell Cannel Coal.

58. *Hopenell*. The former site of an old furnace of that name.

59. *Pactolus*. The former site of an old furnace of that name.

60. *Grayson*. The county seat of Carter County. Coals No. 2 and No. 3 are found here. Iron Hills Furnace, the largest charcoal furnace in this section, is situated about eight miles northwest from Grayson, where also is the celebrated Lambert Ore Bank, a local deposit 14 feet 10 inches thick, of great value. Thirteen miles west of Grayson are the celebrated Carter Caves, situated in the St. Louis group of the Sub-Carboniferous limestone. These caves and the wild scenery of Tigart Valley, surrounding them, are well worth visiting.

61. *Mt. Savage*. Near here is Mt. Savage Furnace, and fine veins of coals No. 3 and No. 7, the latter known as the Coalton Coal.

62. *Willard*. At Willard are the ores and coal mines of the Bellefonte & Etna Company of Iron-ton, Ohio. Most of the coals are represented in this vicinity.

63. *Peach Orchard*. Extensive mines, Coal No. 3.

64. *Wickliffe*. County seat of Ballard County. The railroad just south of this passes at the foot of an exposure of lignite three feet thick.

65. *Columbus*. The town lies at the foot of river bluffs, 120 feet high, showing Quaternary and Tertiary strata. Port Hudson clays exposed beneath Alluvium in river bank at low water.

The Quaternary gravel and brown loam beds, that cover almost the entire region lying between the Tennessee and Mississippi Rivers, are very generally underlaid by black and blue clays of the lignitic group of Eocene Tertiary. These clays have, in and near Paducah, been penetrated to a depth of 100 feet. Cretaceous sands and clays underlie the Quaternary thirty-five miles southeast of Mayfield.

Errata for Kentucky.

In note 20 and 21. The first line of 21 belongs to 20, *Henderson*.

In note 46, *Paducah*. Corniferous conglomerate should be Carboniferous conglomerate.

In the Chesapeake, Ohio & Southwestern R. R. the geological formation of Calvert City and Paducah should be "20. Quaternary, Port Hudson." That of Boaz, *et al.*, to Fulton, should be "20. Quaternary gravel and loam over Eocene Tertiary."

The elevation of Princeton should be 524; Calvert city, 351; and Paducah, 341 feet. The same error affects the elevations of all stations south of Paducah and east to Elizabethtown.

Tennessee.¹

LIST OF GEOLOGICAL FORMATIONS FOUND IN TENNESSEE:

DANA'S TABLE OF FORMATIONS.	TENNESSEE DIVISIONS. BY PROF. SAFFORD.	DANA'S TABLE OF FORMATIONS.	TENNESSEE DIVISIONS. BY PROF. SAFFORD.
20. QUATERNARY.	20 c. Alluvium.	7. HELDERBERG.	7. Held. or Linden.
"	20 b. Bluff Loam.	5. NIAGARA.	5 d. Niagara lime s.
"	20 a. Orange sand, or drift.	" CLINTON.	5 c. Dyestone Group
19. TERTIARY EOCENE	19 b. La Grange s.	" MEDINA.	5 b. White Oak Mt. sandstone.
"	19 a. Flatw'ds s. & c.	"	5 a. Clinch Mt. s. s.
18. CRETACEOUS.	18 c. Ripley Group.	4 b. CINCINNATI.	4 b. Nashville.
"	18 b. Rotten lime s.	4 a. TRENTON.	4 a. Lebanon.
"	18 a. Coffee sand.	3. CANADIAN. QUEBEC	3 d. Lenoir or Chazy
14. CARBONIFEROUS.	14. Coal Measures	"	3 c. Knox dolomite.
13. SUB-CARBONIFEROUS.	13 c. Mountain l. s.	"	3 b. Knox shale.
"	13 b. Coral or St. Louis l. s.	" CALCIFEROUS.	3 a. Knox sandstone
"	13 a. Barren Group.	2. PRIMORDIAL. POTOMAC.	2 b. Chilhowee s. s.
10. HAMILTON.	10 c. Black Shale.	" ACADIAN.	2 a. Ocoee Group.
		1. ARCHÆAN.	1. Metamorphic.
Chesapeake, Ohio & Southwestern R. R. Ms. Alt.		Chesapeake, Ohio & Southwestern R. R. Ms. Alt.	
0 Paducah, Ky.	20. Quaternary. 434	68 Polk's.	20 b. Bluff loam.
5 Bond's.	"	74 Obion.	"
9 Florence.	"	78 Trimble.	"
14 Boaz.	"	85 Newbern.	"
16 Viola.	"	94 Dyersburg.	"
20 Hickory.	"	98 Foulkes.	"
26 Mayfield.	"	107 Gates.	"
32 Pryor's.	"	119 Ripley.	"
37 Wingo.	"	125 Hennings.	"
44 Water Valley.	"	133 Covington.	"
50 Fulton.	"	145 Atoka.	"
53 Pierce, Tenn.	20 b. Bluff loam.	151 Kerrville.	"
56 Harris.	" Resting on 20 a.,	154 Millington.	"
59 Paducah Junct'n.	" and that on 19 b.	158 Lucy.	"
63 Troy.	" La Grange sand.	170 Memphis. ²	"

1. Revised, and the notes added by Prof. James M. Safford, the State Geologist of Tennessee, and the portion in Kentucky by Prof. N. S. Shaler, the State Geologist of Kentucky.

2. *Memphis*. The Bluff loam is well displayed in the bluffs at Memphis, no other formations appearing, excepting in very low water.

Vicksburg. The peculiar property of the Loess, or Bluff formation is shown in the following passage from General Grant's article on the Siege of Vicksburg, in the *Century* magazine, for September, 1885: "The ridges upon which Vicksburg is built, and those back to the Big Black, are composed of a deep, yellow clay, of great tenacity. When roads and streets are cut through, perpendicular banks are left, and stand as well as if composed of stone. The magazines of the enemy were made by mining passageways into this clay, at places where there were deep cuts. Many citizens secured places of safety for their families by carving out rooms in these embankments. A door-way, in these cases would be cut in a high bank, starting from the level of the road, or street, and after mining it in a few feet a room of the size required would be carved out of the clay, the dirt being removed by the door-way. In some instances I saw where two rooms were cut out for a single family, with a door-way in the clay wall separating them; some of these were carpeted, and furnished with considerable elaboration. In these the occupants were fully secure from the shells of the enemy, which were dropped into the city night and day, without intermission." A lady who was in the city during the siege, reported the hills as honey-combed with caves, the digging of which became a regular business. They were well propped with thick posts, as in a coal mine.

Mobile & Ohio Railroad.			Louisville & Nashville Railroad.—		
Ms.		Alt.	Ms.	Continued.	Alt.
0	Columbus, Ky.	{ 20. Quat., 20 b. Bluff loam 10 miles. 309	184	Steele's.	{ 18 b. Sub.-Carbon., St. Louis l. s. 365
7	Clinton.	" 321	189	Palmyra.	" 367
18	Moscow.	" 313	190	Carbondale.	" 363
16	Cayce's.	" 400	198	Cumberland.*	18 a. Sub.-Carbon. 359
20	Jordan, Ky.	" 404	205	Erin.	" 404
26	Union City, Tenn.	" 346	210	Tenn. Ridge.	18 b. Sub.-Carbon. 720
81	Troy.	"	214	Stewart's.	" 464
45	Crockett.	" 396	220	Tenn. River.	18 a. Sub.-Carbon.
43	Kenton.	{ 2 a. Orange sand, resting on La Grange sand. 309	230	Big Sandy.	7. Helderberg. 345
48	Rutherford.	" 321	235	Springville.	{ 20 a. Orange sand, 18 c. Ripley. 349
52	Dyer.	" 365	241	Porter's.	19 a. Flatwoods. 353
59	Trenton.	" 321	246	Paris.*	{ 20 a. Orange sand, 19 a. Flatwoods. 447
70	Humboldt.	" 329	256	Henry.	20 a. Oranges. 513
79	Carroll.	" 375	264	McKenzie.	" 470
87	Jackson.	" 425	274	Trezevant.	" 443
89	Pinson.	19 a. Flatwoods. 384	284	Milan.	" 403
103	Henderson.	" 427	296	Humboldt.	" 329
114	McNairy.	18 c. Ripley. 454	301	Gadsden.	" 406
120	Bethel.	" 463	308	Bell's.	" 320
132	Ramer, Tenn.	18 b. Rotten l. s. 416	312	Jones's.	" 314
143	Corinth, Miss.	" 434	321	Brownsville.	" 333
Illinois Central Railroad. (N. O., Louisville & Chicago Division.)			329	Shepherd.	" 379
			333	Stanton.	" 303
			341	Mason.	" 396
			349	Galloway.	" 377
			352	Withe.	20 b. Bluff loam. 371
			358	Shelby.	" 249
			366	Bartlett.	" 268
			377	Memphis.*	" 227
			(Division to Nashville and Montgomery.)		
			0	Louisville, Ky.	433
0	New Orleans.		114	Bowling Green.	18 b. Sub.-Carbon. 366
382	Lamar, Tenn.		118	Memphis Junct.	"
394	Grand Junction.	{ 20 a. Orange sand, resting on La Grange sand. 575	122	Rich Pond.	"
413	Bolivar.	" 430	125	Woodburn.	"
441	Jackson.	" 425	184	Franklin.	" 617
455	Medina.	"	141	Mitchellville, Tn.	18 a. Sub.-Carbon. 746
464	Milan.	" 403	144	Richland.	" 774
475	Bradford.	"	146	Fountain Head.	" 778
481	Greenfield.	"	149	Buck Lodge.	" 711
487	Sharon.	"	153	(Tunnel.) ³	10 c. Bl. Sh. " 5 d.
495	Frost.	"	159	Gallatin.	4 b. Cin. or Nash. 434
550	McConnellville.	"	164	Pilot Knob.	" 447
506	Fulton, Ky.	20 b. Bluff loam.	166	Saundersville.	" 845
Louisville & Nashville Railroad. (Memphis Division.)			170	Hendersonville.	" 446
			175	Edgefield Junct.	{ 4 b. Cin. or Nash., and 4 a. Tren. 416
			178	Madison.	4 b. Cin. and Nash. 466
			0	Louisville, Ky.	433
			164	Guthrie.	{ 13 b. Sub.-Carbon., St. Louis l. s. 525
			168	Hampton's, Tenn.	" 513
171	Dudley's.	" 494			
177	Clarksville.	" 392			

3. Very soon after leaving Cumberland, the road traverses one end of the *Wells Creek Basin* and crosses the 10 c. Black Shale, also 7. Helderberg, 5 d. Niagara, 4 a. Lebanon, 4 b. Nashville, and 3 c. Knox Dolomite strata, which have been brought to the surface by an uplift. The only exposure of Knox Dolomite in Tennessee west of the Cumberland Mountains. In the bluff on the river just below Cumberland are good presentations of the 10 c. Black Shale, as well as the 5 Niagara, and 7. Helderberg rocks.

4. *Paris.* At the Paris depot the Orange Sand is well seen in the railroad cuts, and in the washes about the town. In the cuts of the railroad just east of the depot, and also on roads leading to the southeast from the town, the Flatwoods clay can be observed to advantage.

5. At this Tunnel is a good section of the (10 c.) Black Shale, with the strata above and below.

Louisville & Nashville Railroad.—			East Tennessee & Western North Carolina Railroad. ¹		
Ma.	Continued.	Alt.	Ma.		Alt.
184	Edgefield.	4 b. Cin. or Nash.	0	Johnson.	3 c. Knox.
185	Nashville.	"	9	Elizabethtown.	"
189	N. and C. Junc.	"	15	Hampton.	"
197	Brentwood.	"	24	Crab Orchard.	"
206	Franklin.	"	33	Cranberry.	1 b. Huronian.
215	Thompson's.	"	34	Mine.	"
219	Ewell's.	"	Louisville & Nashville Railroad.		
223	Carter's Creek.	4 a. Lebanon.	(St. Louis Division.)		
233	Columbia.	"	0	St. Louis.	
243	Pleasant Grove.	"	261	Trenton, Ky.	
246	Campbell's.	"	269	Guthrie.	13. Sub-Carbon.
251	Lynnville.	"	274	Forts, Tenn.	"
254	Buford's.	"	280	Cedar Hill.	"
256	Reynold's.	"	287	Springfield.	"
261	Wales.	"	299	Baker's.	{ 5 a. Niagara, with
266	Pulaski.	"			{ bl'k shale above. A
272	Harwell.	"			{ good section here.
273	Aspen Hill.	"	303	Goodlett's.	4 b. Nashville.
275	Lester's.	"	306	Edgefield Junc.	{ 4 b. Nashville and
278	Prospect.	"			{ 4 a. Lebanon.
280	State Line.	4 b. Cincinnati.	309	Madison.	4 b. Nashville.
286	Elkmont, Ala.	18. Sub-Carbon.	315	Edgefield.	"
	(Continued in Alabama.)		316	Nashville.	"
East Tennessee, Virginia & Georgia R. R.			Nashville, Chattanooga & St. Louis R. R.		
0	Memphis, Tenn. ²	20 b. Bluff l'm.	0	Chattanooga. ³	{ 4 a. Lebanon, and 3
5	Buntyn.	"			{ c. Knox dolomite or
9	White's.	"			{ Quebec.
15	Germantown.	"	6	Wauhatchie.	4 b. Nashville.
19	Bailey.	"	13	Etna Cl. Mines.	{ 18 c. Upper Sub-
23	Colliersville.	"	14	Whitesides.	{ Carb., 14. Cl. Meas-
31	{ Rossville, or	20 a. Oranges.			{ ures near by.
	{ La Fayette.		22	Shellmound.	{ Alluvium (Tenn.
39	Moscow.	"			{ river bottom.)
52	Somerville.	"	28	Bridgeport.	{ 3 c. Knox dolomite
49	La Grange.	"			{ or Quebec.
52	Grand Junc.	"	39	Stevenson. ⁷	3 b. Knox shale.
58	Saulsbury.	"	49	Anderson.	13. Sub-Carboniferous.
64	64 Miles Siding.	19 a. Flatwoods.	62	(Tunnel). ⁸	13 c. Mountain l. s.
69	Middleton.	18. Cretaceous.	64	Cowen.	13 b. Sub-Carbon.
74	Pocahontas.	"	69	Dechard.	"
79	Big Hill.	{ 20 a. Orange sand,	82	Tullahoma.	13 a. Sub-Carbon.
		{ 19 a. La Grange.	89	Normandy.	4 b. Nash. or Cin.
84	Chewalla.	18 c. Rotten l. s.	96	Wartrace.	{ 4 b. Nashville and
93	Corinth, Miss.	{ 20 d. Yellow loam,			{ 4 a. Lebanon.
		{ 18 c. Rotten l. s.	101	Belle Buckle.	4 a. Lebanon.
107	Burnsville, "	{ 20 a. Orange sand,			"
		{ 18 a. Eutaw.	109	Christiana.	"
115	Iuka, Ala.	{ 20 a. Orange s.,	119	Murfreesboro.	"
		{ 13 a. Keokuk or St. L.	126	Florence.	"
124	Marguren, Ala.	13. Sub-Carboniferous.	131	Smyrna.	"
127	Dickson.	"	136	Lavergne.	"
129	Cherokee.	"	142	Antioch.	"
	(Continued in Alabama.)		150	Nash. & Dec. Jo.	4 b. Nashville.
			151	Nashville.	"

6. Upper Silurian beds, the Black Shale and the lowest carboniferous strata, may also be seen in the high hill on the west side of the city.

7. Stevenson. A fault here bringing Knox Shale and Sub-Carboniferous together.

8. Tunnel. Coal measures on the tops of the mountains each side of the tunnel.

Nashville, Chattanooga & St. Louis R. R.— Ms. <i>Continued.</i> Alt.			Nash., Chattanooga & St. Louis R. R.— Ms. (McMinnville and Sparta Branch.) Alt.		
158 { Bellemeade, or Harding's.	4 b. Nashville.		0 Tallahoma.	{ 18 a. Sub-Carbon.,	
164 Bellevue.	"		12 Manchester.	{ barren ground.	
168 Newsom's. ⁹	5 a. Niagara.		35 McMinnville.	{ 18 b. Sub-Carbon.	
176 Kingston Spring.	13. Sub-Carboniferous.		46 Rock Island.	{ St. Louis l. a.	
189 Burns.	"		61 Sparta.	"	
193 Dickson.	"		(Jasper Branch.)		
208 McEwen.	"		0 Bridgeport.	8 c. Knox dolomite.	
218 Waverly.	"		6 S. Pittsburgh.	"	
229 Johnsonville.	{ 10 c. Blk shale, and 13. L. Sub-Carbon.		12 Jasper.	18 b. Sub-Carbon.	
238 Camden. ¹⁰	13. Helderberg.		19 Victoria.	"	
258 Huntingdon.	19 a. Flatwoods Terti.		24 Sequatchee.	Silurian.	
270 McKenzie. ⁴⁷⁰	20 a. Orange s.		25 Inman.	Iron ore mines.	
278 Gleason.	"		(Centerville Branch.)		
285 Dresden.	"		0 Dickson.	18 b. Sub-Carb.	
303 Paducah Junc.	"		11 Bon Aqua.	"	
307 Union City. ³⁴⁵	20 b. Bluff loam		17 Warner.	"	
314 State Line, Tenn. (Continu'd in Ky)	"		24 Graham.	"	
321 Hickman, Ky.	"	301	34 Centerville.	5 d. Niagara.	
333 Columbus, "	"	309	Tennessee Coal and Iron Co.'s R. R.		
499 St. Louis, Mo.	"		0 Cowan.	{ 18 b. Sub-Carbon, St. Louis l. a.	
(Lebanon Branch.)			9 Sewanee.	14. Coal Measures.	
0 Nashville.	4 b. Nashville. ⁴³⁰		15 Monteagle.	"	
2 Mt. Olivet.	4 b. Nash., 4 a. Tren.		21 Tracy City. ¹¹	"	
8 Donelson.	"		East Tennessee, Virginia & Georgia Railroad.		
12 Hermitage.	"		0 { Bristol, at Va. Line.	{ 3 c. Knox dolomite, or Quebec.	
18 Mt. Juliet.	"		11 Union. ¹²	"	1457
24 Leeville.	"		20 Carter's. ¹²	"	
26 Tucker's Gap.	4 b. Nashville.		25 Johnson's. ¹²	"	1643
31 Lebanon.	4 a. Lebanon.		32 Jonesboro.	"	1784
(Shelbyville Branch.)			43 Limestone.	"	
0 Chattanooga.		634	47 Fuller's.	"	
96 Wartrace.	4 b. Nash., 4 a. Leban.		56 Greeneville. ¹³	"	1581
104 Shelbyville.	4 a. Lebanon.		65 Midway.	"	
(Fayetteville Branch.)			74 Rogersville Jc.	4 b. Nashville.	
0 Decherd.	{ 18 b. Sub-Carbon., St. Louis l. s.		82 Russellville.	{ 3 c. Knox dolomite, or Quebec.	
3 Winchester.	"		88 Morristown.	"	1233
10 Belvidere.	13 a. Sub-Carbon.		97 Talbot's.	"	
16 Hunt's.	"		101 Mossy Creek. ¹⁴	"	
26 Cunningham.	4 b. Cin. or Nashville.		105 Newmarket.	"	1037
28 Brighton.	"		114 Strawberry Pls.	"	
32 Kelso.	"				
37 Fayetteville.	"				

9. At Newsom's a section may be conveniently seen extending from the upper part of the 4 b. Nashville to the 13. sub-carboniferous.

10. Camden. Half a mile west of Camden depot the railroad crosses "the old shore line" and passes from the ancient Paleozoic strata on to the Tertiary and Quaternary ones, the limestones, cherts, etc., disappearing, and the softer sands and clays taking their place.

11. At Tracy City is a good bed of coal, extensively mined. In this vicinity a good section of the coal measures of this part of Tennessee can be obtained. (See "The Coal Regions of America," pages 351 to 373.)

12. Within a few miles of these Stations are ridges and knobs made up of dark shales of Cincinnati or Nashville age. At Johnson's a point of one of these ridges is very near the Station.

13. The high mountains so conspicuous from the depot at Greeneville are made up of 2 b. Chilhowee (Potsdam) sandstone, and of 2 a. Ocoee slates and conglomerates.

14. Veins of zinc ore are found at this point in the 3 c. Knox dolomite.

East Tennessee, Virginia & Georgia Railroad.—Con.			East Tennessee, Virginia & Georgia R. R. (Marysville Branch.)—Con.		
Ms.		Alt.	Ms.		Alt.
120	McMillan's.	{ 3 c. Knox dolomite, or Quebec.	.....	Little River.	Unknown.
130	Knoxville. ¹⁵	{ 3 c. Knox dolomite and Trenton. ⁹⁰⁰	16	Marysville.	3 c. Knox dolomite.
135	Erin.	4 a. Tren. & Nash. ⁴⁰⁴	(Ohio Division.)		
145	Concord.	3 c. Knox dolomite.	0	Knoxville. ¹⁵	2-4. Lower Silurian.
154	Lenoirs. ¹⁶	"	9	Powell's.	"
159	Loudon.	" 816	14	Heiskell's.	"
165	Philadelphia.	"	21	Clinton.	{ 4 a. Trenton and 3 c. Upper Knox.
175	Sweetwater.	"	27	Cane Creek. ¹⁸	2-4. L. Silurian.
180	Reagan's.	3 b. Knox shale.	31	Offutt's.	" (?)
186	Athens.	3 c. Knox dolomite ⁹³³	38	Careyville.	14. Coal Measures.
193	Riceville.	3 b. Knox shale.	47	Buckeye.	"
201	Charleston.	3 c. Knox dolomite.	55	Elk Valley. ¹⁹	" (fault.)
213	Cleveland.	{ 3 c. Knox dolomite and shale. 878	62	Newcomb.	"
	State Line.		66	Jellico.	"
	(Continued in Georgia.)		Cincinnati, N. O. & Texas Pacific R. R. (Late Cincinnati Southern Railroad.)		
240	Dalton.	3 c. Knox dolomite.	0	Cincinnati.	(See Ohio.)
213	Cleveland.	" 878	198	State Line of Tn.	11 b. L. Cl. Measures.
227	Ooltawah. ¹⁷	4 a. Trenton.	201	Winfield.	"
232	Tyner's.	3 b. Knox shale.	206	Oneida.	" 1454
242	Chattanooga.	{ See N. C. & S., and S. R. R. 684	211	Helenwood.	" 1400
			216	New River.	" 1215
			219	Robbins.	" 1382
			221	Rugby Road.	"
			223	Glen Mary.	" 1289
			229	Sunbright.	" 1359
			234	Annadel.	" 1249
			238	Lancing.	" 1197
			243	Nemo.	" 917
			251	Oakdale Junc.	" 812
			257	Elmore Gap.	" (?) 840
			265	Rockwood. ²⁰	L. Silurian Knox. 885
			270	Glen Alice.	" 828
			273	Roddy.	" 784
			277	Lorraine.	" 813
			280	Spring City.	" 781
			285	Sheffield.	"
			291	Darwin.	" 767
			297	Dayton.	" 715
			304	Coulterville.	" 712
			307	Rock Creek.	" 753
			309	Retro.	" 747
			314	Rathbun.	" 788
			318	Melville.	" 711
			326	Hixon's.	"
			331	Boyce.	" 694
			335	Chattanooga. ²⁰	" 684

East Tennessee, Virginia & Georgia R. R. (North Carolina Division.)

0	Morristown.	{ 3 c. Knox dolomite, or Quebec. 1283
4	Sulphur Springs.	{ 3 b. Knox shale and dolomite.
6	Witt's Foundry.	"
19	Dandridge Road.	"
12	Leadville.	{ 4 b. Shales of Cin. or Nashville age.
15	Rankin's.	{ 3 c. Knox dolomite, Nashville shales.
.....	Newport.	"
26	Bridgeport.	3 c. Knox dolomite.
33	Big Creek.	{ 3 c. Knox dolomite, and 2 a. Ocoee Conglomerate & shales.
39	Wolf Creek.	{ 2 a. Ocoee Conglomerate and shales.

(Marysville Branch.)

0	Knoxville.	{ 3 c. Knox dolomite, and 4 a. Trenton. ⁹⁰⁰
.....	Bruce's.	Unknown.

15. The high portion of the city on the former, the depot on the latter. Shales of Nashville just west of depot. On the side of the Holston River opposite Knoxville high knobs covered with deep red soil are conspicuous, which are made up in good part of a dark ferruginous limestone, called Iron Limestone, and which belongs to the 4 b. Nashville (Cincinnati) group.

16. *Lenoirs.* Depot on junction of the Lenoir or Chazy limestone and the Knox dolomite. The former lies to the southeast, and the latter to the northwest.

17. About one mile east of Ooltawah the railroad passes through a gap of the White Oak Mountains, in which is an interesting section embracing 4 b. Nashville, 5 d. Niagara, Devonian (10 c. Black Shale) and 13 Sub-Carboniferous rocks.

18. From Knoxville to Cane Creek the stations are either on the Knox divisions or the Trenton.

19. *Elk Valley* is on a fault, and in the upper part of the narrow valley the Trenton, the red Clinton ore, the Sub-Carboniferous limestone, and the Coal Measures may be seen and studied.

20. Although Professor Safford knows the geology of the country passed over, he has not traveled on this railroad, and therefore the sub-divisions of the Lower Silurian are not given. From Rockwell to Chattanooga the stations are mostly on his Knox divisions, but in a few cases on Trenton.

Arkansas.

GENERAL GEOLOGY OF THE STATE.—Dividing the State diagonally from northeast to southwest, beginning near the easterly boundary of Randolph county and running thence past Grand Glaize and Little Rock, through to Fulton in Hempstead county on Red River, (consequently nearly in the line of the St. Louis, Iron Mountain & Southern Railroad), almost all the State, east of said line, will be found of the 19. Tertiary formation, except along the river bottoms, where it is 20. Quaternary. The northern portion, west of said line, is mostly 2-8. Silurian, with some 9-12. Devonian and 14. Carboniferous further south; the middle western part of the State being 14. Carboniferous, while the south-west part (namely, from Arkadelphia and Murfreesboro south and west) will be found 18. Cretaceous.

In consequence of the above general arrangement of the geological formations in the State, it will be readily perceived that the St. Louis, Iron Mountain & Southern Railroad runs mainly near the junction between the Silurian, Carboniferous and Cretaceous of the west side, and the 19. Tertiary, with some 20. Quaternary, of the east side. Further, that the Arkansas Midland is chiefly in the 19. Tertiary and 20. Quaternary, while the Little Rock & Fort Smith Railroad passes through the 14. Carboniferous formation; also, that the Memphis & Little Rock Railroad runs through 19. Tertiary and 20. Quaternary.

The State affords abundance of manganese, zinc and kaolin.

The expression, "Quaternary over Silurian," is intended to indicate that the superficial deposits of the locality, opposite which the remark is placed, are Quaternary; but that when lower formations are exposed by denudation, &c., they would be found Silurian. A similar interpretation is designed to be given to "Tertiary over Cretaceous," and the like expressions. R. O.

Arkansas Midland Railroad.			Missouri Pacific Railroad.		
Ms.		Alt.	Ms.	St. Louis, Iron Mount'n & South'n Div.	Alt.
0	Helena.	20. Quat. over 19. Ter.	186	Moark.	267
10	Bushville.	"	192	Corning.	294
21	Marvell.	"	203	Peach Orchard.	290
30	Palmer's.	"	214	O'Kean.	276
40	Duncan.	"	225	Walnut Ridge.	275
48	Clarendon.	"	232	Minturn.	251
63	Brinkley.	" 200	244	Swifton.	253
Little Rock & Fort Smith Railroad.			262	Newport.	233
0	Argenta.	14. Carboniferous. 301	273	Grand Glaize.	14 a. Mills. Grit. 226
10	Warren.	" 331	278	Bradford.	" 246
30	Conway.	14 b. Lower Coal 361	292	Judsonia.	" 222
44	Plumerville.	Mrs. " 333	305	Garner.	" 211
63	Atkins.	" 399	312	Beebe.	" 250
83	Georgetown.	"	320	Austin.	" 258
95	Cabin Creek.	" 449	332	Jacksonville.	" 287
101	Clarksville.	" 409	345	Little Rock. ¹	14. Carboniferous. 263
125	Ozark.	" 424	355	Mabelvale.	"
150	Alma.	" 477	368	Benton.	" 283
159	Van Buren.	" 449	388	Malvern.	" 277
168	Cherokee.	"	410	Arkadelphia. ²	{ June. of 14. Carb., 18. Creta. & 19. Ter. 191
Memphis & Little Rock Railroad.			437	Boughton	19. Ter. over 18. Creta.
0	Memphis.	20. Quat. over 19. Ter.	449	Emmet.	"
17	Edmondson's.	"	457	Hope.	" 357
33	Black Fish Siding.	"	471	Fulton.	" 272
41	Madison.	" 207	490	Texarkana.	{ 20. Quaternary over 19. Tertiary. 303
53	Palestine.	"	Hot Springs Railroad.		
70	Brinkley.	" 200	388	Malvern.	{ 14 b. Lower Coal Measures. 277
87	De Vall's Bluff.	{ 19. Tertiary over Mills. Grit. 181	406	Rockport.	"
103	Carlisle.	"	413	Hot Springs. ³	{ 14 a. Millstone Grit. 713
112	Lonoke.	"			
125	Galloway.	"			
135	Little Rock. ¹	14. Carboniferous. 263			

*This page is by Richard Owen, M. D., LL. D., of New Harmony, Indiana, the rest of the road were prepared by Professor R. H. Loughridge, now of the Kentucky Geological Survey.

1. *Little Rock.* In Pulaski county, west of Little Rock, excellent granite is quarried. R. O.

2. *Arkadelphia.* In the ridges pervading Montgomery county, which adjoins Clark county on the north-west, there are gorges which furnish the "crystal hunter" vast quantities of rock crystal, sent extensively to mineralogical cabinets. R. O.

Missouri Pacific Railroad.			Arkansas Valley Route.		
St. Louis, Iron Mountain & South'n Div.—Con.			(Little Rock Division.)		
Ms.	(Helena Branch.)	Alt.	Ms.		Alt.
0	Knobel.	{ 20. Quaternary over 19. Tertiary. 271	0	Little Rock ¹	14. Carboniferous. 263
13	Gainesville.	" 500	5	Sweet Home.	20. Quat. over 19. Ter.
21	Parmly.	"	12	Wrightsville.	"
34	Brookland.	"	22	Redfield.	"
45	Ridge.	"	27	Jefferson Springs.	"
58	Harrisburg.	"	42	Pine Bluff.	"
69	Cherry Valley.	"	55	Linwood.	"
76	Vanndale.	"	69	Varner.	"
98	Forrest City.	" 281	81	Dumas.	"
114	Marianna.	"	94	Tillar.	"
127	Lexa.	"	106	Trippie Junc.	"
140	Helena.	"	113	Arkansas City.	20. Alluvium.
(White River Branch.)			(Ouachita Division.)		
0	Newport.	{ 20. Quaternary over 5-7. Silurian.	0	Arkansas City.	20. Alluvium.
8	Diaz.	"	7	Trippie.	20. Quat. over 19. Ter.
9	Paroquet.	5-7. Silurian.	17	Dermott.	"
14	Newark.	13. Sub-Carb.	25	Collins.	"
24	Moorefield.	"	40	Monticello.	"
29	Batesville.	"	56	Warren.	"
(Camden Branch.)			Kansas City, Fort Scott & Gulf R. R.		
0	Gurdon.	{ 20. Quaternary over 19. Tertiary. 213	(Thayer to Memphis.)		
7	Whelan.	"	340	Thayer.	5-7 Silurian.
18	Chidester.	"	343	Mammoth Spring	"
24	Dowling.	"	369	Williford.	"
34	Camden.	"	381	Imboden.	"
Texas & St. Louis Railway.			390	Black Rock.	20. Quat. over Sil. (?)
(Missouri and Arkansas Division.)			399	Hoxie.	{ 20. Quaternary over 19. Tertiary. 290
0	Birds Point, Mo.	20. Alluvium. 321	412	Bonnerville.	"
58	Malden, Mo.	" 297	424	Nettleton.	"
70	St. Francis.	" 333	431	Big Bay.	20. Alluvium.
79	Greenway.	20. Quat. over 19. Ter.	459	Gilmore.	"
86	Rector.	"	474	Marion.	"
104	Paragould.	"	484	West Memphis.	"
116	Brookland.	"	487	Memphis.	20 c. Quaternary, bluff.
125	Jonesboro.	"	St. Louis & San Francisco R. R.		
155	Fisher.	"	(Arkansas Division.)		
179	Bemis.	"	0	Fort Smith.	14. Carboniferous. 467
199	Brinkley.	" 200	7	Van Buren.	" 449
214	Clarendon.	"	27	Mountainburg.	"
238	Goldman.	20. Alluvium.	47	Brentwood.	"
251	Wabbaseca.	"	65	Fayetteville.	"
260	Rob Roy.	"	85	Rogers.	"
267	Pine Bluff.	20. Quat. over 19. Ter.	98	Garfield.	"
284	Big Creek.	"	104	Seligman, Mo.	13 c. Low. Carbon.
300	Kingsland.	"	Eureka Springs Railway.		
337	Camden.	" 123	0	Eureka Springs.	14. Carboniferous.
348	Senter.	"	9	Walden.	"
368	McNeil.	"	19	Seligman, Mo.	13 c. Low. Carbon.
389	Lewisville.	"			
397	Garland City.	20. Alluvium.			
418	Texarkana.	{ 20. Quaternary over 19. Tertiary. 303			

3. Hot Springs. Celebrated alkaline hot springs. In the southwestern part of this county is the noted Magnet Cave, in and around which are found many beautiful minerals, especially magnetite, or magnetic iron ore, garnets, actinolite, epidote and crystallized hornblende, also the celebrated novaculite or Ouachita, sometimes spelled "Washita," honestone, also called Arkansas whetstone. R. O.

Indian Territory.

The list of Formations is at the head of the Texas Chapter.

Geology of Indian Territory.—The eastern part of the Indian Territory is made up almost entirely of the representative sandstones, limestones, etc., of the Coal Measures, the former rock capping the mountains of the east, and becoming the prevailing feature in the lower hills and country westward, while the limestone which appears prominently in the mountain sides and valleys of the east, disappears almost entirely in the west, or is exposed only in the beds of the largest streams. Carboniferous coal mines are extensively worked on the south of the Canadian river, by companies who have leased them from the Nation. The Permian is said to cover an area south of the Wichita Mountains on the southwest, while the remainder of the western part of the Territory is thought to belong to the Triassic and Jurassic, except the regions of the mountains which are of granitic structure, their granites flesh colored, and associated with greenstone, quartz, porphyry, etc.—*Dr. R. H. Loughridge's Cotton Report, Census of 1880.*

Missouri, Kansas & Texas R. R.			Missouri, Kansas & Texas R. R.— <i>Continued.</i>		
Ms.		Alt.	Ms.		Alt.
855	Vinita.	698	556	Durant.	633
879	Pryor Creek.		568	Colbert.	658
888	Chouteau.	624	576	Denison, Texas.	722
410	Gibson.	588	Atlantic & Pacific Railroad.		
419	Muskogee.	599			
449	Eufaula.	617			
470	Reams.	609			
479	McAllister	684	387	Shawnee.	14 b. Coal Measures.
491	Savanna.		342	Prairie City.	"
506	Limestone Gap.	645	348	Oseuma.	"
525	Atoka.	556	353	Afton.	"
536	Caney.	520	358	Albia.	"
544	Caddo. ¹	705	364	Vinita.	" 698
	18. Cretaceous.				

1. The white "Rotten limestone," with an abundance of fossils, is the prevailing rock in this black prairie region, extending southward into Texas, and westward to within a few miles of Tishomingo, Chickasaw Nation.
R. H. L.

Texas.¹

LIST OF GEOLOGICAL FORMATIONS FOUND IN TEXAS AND INDIAN TERRITORY.

Quaternary.	20 c. Alluvium.	18. Cretaceous.	18 b. Upper Creta.
"	20 b. Port Hudson.	"	18 a. Lower Creta.
"	20 a. Stratified Drift.	16 Triassic.	16. Triassic. ?
Tertiary.	{ 19 b. Miocene or	14. Carboniferous.*	14. Coal Measures.
"	Grand Gulf.	2. Lower Silurian.*	2. Cambrian.
"	19 a. Eocene.		

International & Great Northern R. R.			International & Great Northern R. R.		
Gulf Division.		Alt.	San Antonio Division—Con.		Alt.
Galveston.	20. Quat. Pt. Hudson. ³		119 Rockdale.	19. Ter., a. Eoce.	469
Houston.	"	58	145 Taylor.	18. Cretaceous.	
Spring.	{ 19. Tertiary.		162 Round Rock.	"	720
Villis.	b. Miocene.	126	181 Austin.	"	477
Wheeler.	(Grand Gulf.)		212 San Marcos.	"	
Winterside. ²	"	381	230 New Braunfels.	"	
Trinity.	"	377	261 San Antonio. ⁹	"	683
Wheeler.	"	169	274 Medina.	"	
Wheeler.	"	234	315 Pearsall.	19. Ter., a. Eocene.	
Wheeler.	19. Ter., a. Eoce.	300	331 Frio.	"	
Wheeler.	"	350	376 Encinal.	"	
Wheeler.	"	480	394 Webb.	"	
Wheeler.	"	390	415 Laredo. ⁴	"	
Wheeler.	"	495	0 Troupe.	"	467
Wheeler.	"	411	19 Tyler.	"	531
Wheeler.	"	525	44 Mineola.	"	402
Wheeler.	"	467			
Wheeler.	"	507	Columbia Division.		
Wheeler.	"	371	0 Columbia.	{ 20. Quaternary,	
Wheeler.	"	336	18 China Grove.	c. Alluvium.	34
Wheeler.	"	371	30 Houston.	" b. Pt. Hudson. ⁵⁰	37
Wheeler.	"	221			
Wheeler.	"	303			
San Antonio Division.			Georgetown Railroad.		
Wheeler.	19. Ter., a. Eoce.	495	0 Round Rock.	18. Cretaceous.	720
Wheeler.	"	380	10 Georgetown.	"	753
Wheeler.	"	496	Henderson & Overton Branch.		
Wheeler.	"	410	0 Overton.	{ 19. Tertiary,	
Wheeler.	"	420	16 Henderson.	a. Eocene.	507
Wheeler.	"	305		"	

The sub-division of the Carboniferous and Silurian represented here have not been fully ascertained. The Devonian and Upper Silurian seem to be entirely absent.

By Professor R. H. Loughridge, now of the Kentucky Geological Survey, the information derived largely from his personal observations.

Riverside. Fine exposures of Grand Gulf sandstones.

Jacksonville. Tertiary iron ore hills a few miles south.

Laredo. Lignite in heavy beds near here.

Texas & Pacific Railroad.			Texas & Pacific Railroad.		
Ms.	Trans-Continental Division.	Alt.	Ms.	Southern & Rio Grande Division—Con.	Alt.
0	Texarkana.	19. Ter., a. Eoce.	303	190 Terrell.	18. Cretaceous.
17	Whaley's.	"	209	Mesquite.	"
34	DeKalb.	"	222	Dallas.	"
61	Clarkesville.	18. Cretaceous.	484	241 Arlington. ⁶	20. Quater., a. drift.
68	Bagwells.	"	254	Fort Worth. ¹⁰	18. Cretaceous.
91	Paris.	"	592	284 Weatherford. ⁷	20. Quater., a. drift. ⁸⁴⁴
112	Honey Grove.	"	682	308 Brazos.	14. Carboniferous.(?)
128	Bonham.	"	582	358 Eastland.	"
139	Savoy.	"	368	Cisco.	"
142	Bells.	"	675	414 Abilene.	18. Probably Creta.
155	Sherman.	"	747	455 Sweet Water.	"
173	Whitesboro. ⁵	"	473	Lorraine.	"
209	Denton.	"	492	Westbrook.	"
244	Fort Worth. ¹⁰	"	623	512 Signal Mount.	"
Southern & Rio Grande Division.			522	Big Springs. ⁸	"
0	Texarkana.	{ 19. Tertiary, a. Eocene.	303	543 Mariefield.	"
16	Sulphur.	"	602	Metz.	"
44	Kildare.	"	612	Sand Hills.	"
58	Jefferson.	"	623	Aroya.	"
74	Marshall.	"	641	Quito.	"
98	Long View.	"	571	654 Pecos River. ¹¹	"
120	Big Sandy.	"	386	664 Hermosa.	{ The plains are chief- ly Cret.; the mount- ains are part Pal- aeozoic (Carbon.) in part eruptive.
143	Minneola.	"	386	684 Gomez.	
157	Grand Saline.	"	402	705 Kent.	
174	Will's Point.	"	400	736 Wild Horse.	
		"	530	754 Carrizo.	

5. *Whitesboro.* The belt of Lower Cross Timbers is crossed between this and Denton.

6. *Arlington.* Lower Cross Timbers—a belt of sandy land, 10 to 15 miles wide, timbered with post oak, and reaching from within the Indian Territory southward to the Brazos near Waco.

7. *Weatherford.* Upper Cross Timbers—similar in many respects to the lower belt with which it is united on the north of Red River, but is wider, more irregular in outline, and interspersed with high Cretaceous prairie outliers. It reaches southward from Red River along the western border of the Cretaceous, and crosses the Brazos nearly to the Colorado River.

8. *Big Springs.* Llano Estacado, or the Staked Plain, lying north of this road, is a district of 75,000 square miles in Northwestern Texas, besides the portion in New Mexico, and is a vast and level prairie, as smooth and firm as marble, apparently boundless. The soil is chiefly a brown loam, sometimes sandy, and with no vegetation other than gramma and mesquite shrubs, which appear a few inches above the surface. Alkali ponds or lakes occur frequently, and a number of springs whose waters are suitable for use. Day after day in traveling here, the country is almost perfectly level, except in crossing the sand hills, which are really an object of curiosity. Part of the sand is black; then comes the white sand hills, miniature Alps of sand perfectly white and clean, summit after summit in every direction, not a sign of vegetation upon them, nothing but sand piled upon sand.

9. *San Antonio.* About 80 miles northwest of this place and 18 north of Fredericksburg, in Gillespie County, is a granite hill called Enchanted Rock, a huge granite and iron formation about eight hundred feet high, covering at its base several acres of space, its top being about four hundred yards square. Its name is derived from its magnificent appearance, for when the sun shines upon it in the morning and at evening, it resembles a huge mass of burnished gold. The Azoic rocks found in this central part of the State are mostly of the pink feldspathic variety, resist disintegration, and form high and prominent points or hills throughout the region.

10. *Fort Worth and Cleburne.* The Lower Cross Timber Belt passes east of town. Professor R. P. Whitfield says, Fort Worth is an excellent locality for Cretaceous fossils.

11. *Pecos.* Dr. R. H. Loughridge, in his U. S. Census Cotton Report, describes the several chains of almost treeless mountains in Western Texas, west of the Pecos River, as largely granite, with accompanying sandstones and limestones. In some of the mountains characteristic eruptive rocks are reported as penetrating the later formations, and rising above them in huge masses or forming vertical columns, as in the Organ Mountains near El Paso.

12. *Sierra Blanca.* The great mountain ranges consist, first, next the Pacific coast, and lying from ten to two hundred miles distant from it, the Cordilleras or Coast range, and second the Sierra Nevada, for which see the California chapter. The third is an irregular ill-defined chain, the Sierra Madre, and at El Paso we encounter the western flank of the fourth great mountain chain, the Rocky Mountains, which terminate in what is called the Organ Mountain. Going east from El Paso,

Texas & Pacific Railroad.				Houston & Texas Central R. R.—Con.			
Ms. Southern & Rio Grande Division—Con.		Alt.		Ms. Waco Branch.		Alt.	
777	Sierra Blanco. ¹²	18. Cretaceous,	4512	0	Bremond.	19. Ter., a. Eoce.	467
823	Porter.	Plains, Mts.,	3541	9	Marlin. ¹⁴	18. Cretaceous.	394
832	Rio Grande.	Palae. and erup.	3564	43	Waco.	"	
857	Ysleta.	"	3664	98	Morgan.	"	734
869	El Paso. ¹³	"	3713	128	Hico.	"	1007
Gulf, Western Texas & Pacific Railroad.				150	Dublin.	"	1449
0	Indianola.	{ 20. Quaternary,		197	Cisco.	14. Carboniferous.	1611
25	Placedo.	{ b. Port Hudson.	26	229	Albany.	" (?)	1401
38	Victoria.	"	37	New York, Texas & Mexican Railroad.			
55	Thomaston.	"		0	Rosenberg.	{ 20. Quaternary,	
70	Cuero.	"	177	26	Wharton.	{ b. Port Hudson.	109
Houston & Texas Central Railroad.						{ 20. Quaternary,	
0	Houston.	{ 20. Quaternary,		92	Victoria.	{ c. Alluvium.	
6	Hockley.	{ b. Port Hudson.	37			{ 20. Quaternary,	
51	Hemstead.	"	225	Galveston, Harrisburg & San Antonio R. R.			
71	Navasota.	"	245	Texas & New Orleans Division.			
100	Bryan.	19. Ter., a. Eoce.	219	0	Houston.	{ 20. Quaternary,	
121	Hearne.	"	371	41	Liberty.	{ b. Port Hudson.	37
130	Calvert.	"	305	63	Sour Lake.	"	43
143	Bremond.	"	337	83	Beaumont.	"	47
162	Thornton.	"	467	105	Orange.	"	10
170	Groesbeck.	"	496	0	Houston.	"	37
181	Mexia.	"	481	10	Pierce Junction.	"	63
211	Corsicana.	"	537	34	Richmond.	"	73
239	Palmer.	"	427	53	East Bernard.	"	123
265	Dallas.	18. Cretaceous.	471	70	Eagle Lake.	"	213
296	McKinney.	"	466	86	Columbus.	{ 19. Tertiary,	
329	Sherman.	"	615			{ b. Miocene, Grand	
338	Denison.	"	747			{ Gulf.	213
Western Division.						"	420
0	Hempstead.	{ 20. Quaternary,		102	Weimar.	"	341
11	Chapel Hill.	{ b. Port Hudson.	245	111	Schulenburg.	19. Ter., b. Mioc.	463
21	Brenham.	{ 19. Ter. b. Miocene,		148	Harwood.	" a. Eocene.	418
34	Burton.	{ Grand Gulf.	337	158	Luling.	"	559
47	Ledbetter.	"	350	180	Seguin.	"	566
56	Giddings.	"	436	185	Marion.	"	633
78	McDade.	" a. Eocene.	464	216	San Antonio. ⁹	18. Cretaceous.	
115	Austin.	"	538	241	Lacoste.	"	
		18. Cretaceous.	513	266	Hondo.	"	
				287	Sabinal.	"	891
				308	Uvalde.	"	
				343	Anacacho.	"	
				350	Spofford Junc.	"	

following the river, we encounter two other ranges of mountains at intervals of about eighty miles, called the Eagle Springs or Sacramento Mountains, and the Limpia or Gaudalupe Mountains, in passing through which the river forms a series of cañons (see Note 16). On the Mexican side of the river all these mountains arise again, and expand in width and height and attain a great elevation.

13. *El Paso* is justly considered one of the garden spots of the interior of the continent. The climate is dry, but the settlements are irrigated by water from the river by means of a dam and canal, and are not dependent on rains for their fertility. The place is more than two hundred years old, the settlement having been commenced about 1680, when the Spaniards were driven from New Mexico by the Indians. It is situated in a charming valley, the Rio del Norte having escaped the mountain passes, here runs in an open fertile plain, stretching out along the river to the length of many miles, all the houses surrounded by gardens, orchards and vineyards, and rich settlements, the result of judicious irrigation, with cornfields as far as the eye can trace the stream lining its great banks. Such a scene will always be attractive, but to a traveler who has passed over the forsaken plains it appears like an oasis in the desert. The mountains southwest of the town consist almost entirely of

Galveston, Harrisburg & San Antonio R. R. Ms. Texas & New Orleans Div.—Continued. Alt.			Galveston, Harrisburg & San Antonio R. R. Ms. Texas & New Orleans Div.—Continued. Alt.		
387 Del Rio.	18. Cretaceous.		0 Harwood.	{ 19. Tertiary, a. Eoc.	
..... Pecos River. ¹⁵	"		..... Gonzales.	(Grand Gulf.) ⁴⁶³	
450 Shumla.	"	1413	0 Pierce June.	"	274
462 Langtry.	"	1304	8 Harrisburg.	20. Quat., b. Pt. Hud. ⁵¹	
491 Lozier.	"	1535	8 Spafford June.	"	31
..... Thurston.	"	1911	83 Eagle Pass.	18. Cretaceous.	
534 Sanderson. ¹⁶	"	2774		19. Ter., a. Eoc. (?) ³⁰⁹	
559 Rosenfield.	"	3665	Gulf, Colorado & Santa Fe Railroad.		
566 Maxon Springs.	"	3538	0 Galveston.	20. Quat., b. Pt. Hud.	
573 Taber. ¹⁷	"	3805	43 Arcola.	"	56
579 Haymond.	"	3883	64 Richmond.	"	73
..... Warwick.	"	4071	94 Sealy.	"	189
595 Marathon.	"	4043			
626 Murphysville.	"	4485	107 Belleville.	{ 19. Tertiary, b. Mioc.	
653 Maria.	"	4592		(Grand Gulf.) ³⁰³	
663 Aragon.	"	4899	126 Brenham.	"	301
689 Valentine.	The Plains are mostly Cretaceous; the Mountains Pal- eozoic and eruptive.	4424	141 Somerville.	"	
720 Haskell.		4013	158 Caldwell.	" a. Eoc.	411
757 Sierra Blanca. ¹²		4512	174 Milano.	"	500
780 Finlay.		3668	188 Cameron.	"	407
795 Camp Rice.		3519	218 Temple.	18. Cretaceous.	595
..... Porter.		3541	242 McGregor.	"	
811 Rio Grande.		3564	270 Clifton.	"	670
836 Ysleta.		3664	280 Meridian.	"	791
848 El Paso. ¹⁸		3713	287 Morgan.	"	734
			317 Cleburne. ¹⁰	"	933
0 Columbus.	{ 19. Tertiary, b. Mioc.		345 Fort Worth.	"	823
31 La Grange. ¹⁸	(Grand Gulf.) ²¹³				

limestone, below which at the foot of the mountain are horizontal layers of compact quartzose sandstone, such as underlie the basaltic and granitic rock for several hundred miles in the prairie toward Santa Fe, and granitic and porphyritic rock seem to a small extent to have burst through the limestone and overlain it.

The Carboniferous limestone is supposed to underlie the whole extent of the country of the southwest, where the Cretaceous and Tertiary appear on the surface. Although of Carboniferous age it is not coal-bearing, being a marine deposit. An ocean existed in the Far West during the Carboniferous period, and the conditions were never such as to admit of the deposit of such materials as form coal beds. All the coal west of Kansas and Indian Territory is Cretaceous.

14. *Martin.* Cretaceous rotten limestone forms the Brazos Falls, five miles south.

15. *Pecos River.* On the Mexican side, five miles south of the river, is a singular peak called the Picotena, rising abruptly from amid the surrounding limestone ranges, shooting up a sharp conical peak of basaltic structure. This peak, by its height and external features, presents a most striking landmark. It is the most northern outlier of an extensive igneous development of the mountain range, rising in jagged peaks to Alpine heights, and presenting in the forest growth which clothes its sides agreeable features of verdure, contrasting strangely with the river valley and its bare outline of desert hills.

16. *Sanderson.* The river cañons. Although the railroad, to shorten distance and for a better route, diverges from the river far to the northward, cutting off the great bend, yet the traveler may wish to know something of the general character of the river valley forming the Mexican boundary. The Rio Grande, from El Paso to the mouth of the Pecos River, south of Langtry station, is characterized by extensive cañons. The river presents a series of basins, more or less extensive, with descending steps and then a cañon. The scenery is unsurpassed for singularity and grandeur. Seventy miles below El Paso, south of Sierra Blanca, the Eagle Springs Mountains converge, and the river makes its way through them in deeply cut chasms, exposing the geological structure in sectional faces presented by its precipitous walls. At the gigantic cañon of San Carlos, twenty miles long, the river presents unbroken walls of limestone, from 200 to a perpendicular height of 1,500 feet. A faint conception only can be formed of the truly awful character of the chasm, which in ascending begins 85 miles and ends 105 miles above the mouth of the Pecos River, and is far from the railroad. Another, the San Vicente cañon, is below the great bend to the northward of the Rio Grande, and equals the San Carlos in many places in ruggedness and grandeur. These cañons were reported by Lieut. Emory to be among the most remarkable features on the face of the globe, namely, a river traversing at an oblique angle a chain of lofty mountains and making through these on a gigantic scale, what in Spanish-America is called a cañon, that is, a river hemmed in by vertical walls. The river is from 80 to 300 feet wide, and at a few points narrows down to 25 or 30 feet, where of course it is very deep and rapid.—*Rep. Mex. Boundary Com.*

17. *Taber.* The igneous rocks. From the commencement of the table land in going westward on this road, broad belts of the Cretaceous formation occur, interrupted here and there by isolated dykes or mounds of trap or other igneous rocks, of modern age, producing a greater or less degree of

Gulf, Colorado & Santa Fe Railroad—Con.			Missouri Pacific R. R. (Texas Extension)—Con.		
Ma.	(Dallas Division.)	Alt.	Ms.	(Jefferson Branch.)	Alt.
0	Cleburne. ¹⁰	18. Cretaceous.	0	Jefferson.	19. Ter., a. Eoc.
18	Alvarado.	"	34	Dangerfield.	"
40	Duncan.	" 1460	50	Pittsburg.	"
58	Dallas.	" 466	70	Winnboro.	"
(Lampasas Division.)			93	Sulphur Spring.	"
0	Temple.	18. Cretaceous.	128	Greenville.	18. Cretaceous.
8	Belton.	" 620	139	Farmersville.	"
56	Lampasas. ¹⁹	"	155	McKinney.	" 618
(Montgomery Division.)			Texas & St. Louis Railroad.		
0	Somerville.	19. Tertiary, b. Miocene	(Texas Division.)		
28	Navasota.	" 219 (G'd Gulf.)	0	Texarkana.	19. Ter., a. Eoc.
55	Montgomery.	"	61	Mt. Pleasant.	"
Houston, East & West Texas Railway.			72	Pittsburg.	"
0	Houston.	20. Quat., b. Pt. Hud. ²³	98	Gilmer.	"
56	Sheperd.	"	106	Big Sandy.	"
72	Livingston.	{ 19. Tertiary, b. Mio.	128	Tyler.	"
88	Moscow.	" (G'd Gulf.)	165	Athens.	"
140	Nacogdoches.	" a. Eoc.	202	Corsicana.	"
Missouri Pacific R. R. (Texas Extension.)			258	Waco.	18. Cretaceous.
(Fort Worth Section.)			278	McGregor.	"
0	Denison.	18. Cretaceous.	305	Gatesville.	" 1000
25	Whitesboro. ⁵	"	Mexican National Railroad.		
43	Pilot Point.	"	0	Corpus Christi.	20. Quat., b. Pt. Hud. ²⁰
61	Denton.	"	53	San Diego.	19. Ter., b. Mio. (?)
96	Fort Worth. ¹⁰	" 623	100	Pena. ²⁰	" (?) (G'd Gulf.)
123	Alvarado.	"	162	Laredo. ⁴	" a. Eocene. 806
150	Hillsboro.	"	Rio Grande Railroad.		
184	Waco.	"	0	Brownsville.	20. Quat., b. Pt. Hud. ²³
198	Lorena.	"	22	Point Isabel.	" (?)
219	Temple Junction.	" 695	Fort Worth & Denver City Railroad.		
258	Taylor.	"	0	Fort Worth. ¹⁰	18. Cretaceous.
0	Whitesboro. ⁵	"	14	Calef.	"
15	Gainesville.	"	25	Rhone.	"
0	Temple Junction.	" 695	40	Decatur.	"
7	Belton.	" 620	51	Alvord.	20. Quat. (?)
0	Denton.	"	59	Sunset.	"
15	Lewisville.	"	68	Bowie.	"
88	Dallas.	" 466	89	Alma.	14. Carboniferous.
(Mineola Section.)			95	Henrietta.	"
0	Denison.	18. Cretaceous.	114	Wichita Falls.	"
52	Greenville.	"			
108	Mineola.	19. Ter., a. Eoc.			

metamorphism of the Cretaceous strata. Toward the west the igneous rocks, which first appear in small isolated knolls, gradually assume more importance and expand into long belts. In the Limpia range the second east of El Paso, these rocks become a mountain chain, having an elevation of 6,000 feet, and extending hundreds of miles north and south. These igneous protusions are composed of greenstone or basalt.—*Idem*.

18. *Lagrange*. A high bluff of Grand Gulf sandstone on south side of the Colorado River; heavy sand beds of Quaternary drift on the north of town.

19. *Lampasas*. A large sulphur spring here.

20. *Pena*. The Sandy Desert is a broad area of white sand, commencing about 20 miles southwest of Corpus Christi, extending northwesterly nearly to the Colorado, and up that river to near Eagle Pass, in a wedge shape. In many places it forms hills from 50 to 100 feet above the grassy plain, and being of a light yellow color are visible at a great distance.

21. *The Cross Timbers*. The peculiar belt of timbered country in Texas, and extending from the Brasos into the Indian Territory and to the Arkansas River, is of undetermined age; but, whatever may underlie the top material at 20 or 30 feet, or perhaps less, it can hardly be questioned that the ferruginous sandstones, pebble conglomerates, sands, and clays that form the surface material, are Quaternary. Their origin will be a matter of doubt until their extent northward is fully ascertained.

This blank space is intended for additional geological notes in pencil by the traveler.

Mexico.

GENERAL NOTE ON THE GEOLOGY OF MEXICO.

As long ago as 1830, William Maclure, the father of American geology, visited Mexico and reported in the *American Journal of Science*, that "the regular order of original stratification was so much deranged throughout that country by the intimate and frequent alternations of volcanic rocks, as to have subverted the original order of nature, and to have changed the class every mile. This leaves the geologist in doubt concerning the sub-strata, and would reduce most of his investigations to hypothetical results." In the previous year, probably the same observer reported in the same journal: "Lava, volcanic tufa, trachyte, clay-slate and a little granite, with porphyry, are predominant rocks in Mexico. Volcanic tufa, trachyte and lava form about ninety-nine hundredths of the country. It affords an extensive field of volcanic rocks, none of which appear to be recent, nor is there any volcano in activity." His travels may have only extended from Vera Cruz to the city of Mexico.

Not being able to procure a detailed report of the geology along the lines of the several Mexican railroads, such general information is here given as to some localities as could be collected from the reports of travelers, and in attempting this, some valuable and unexpected contributions have been received from some of the Pennsylvania geologists, rendering important aid in an almost hopeless task. The reader is also referred to the notes on Texas as to the formations found along the United States and Mexican boundary, which, together with what is given in the chapters on New Mexico and California, will throw some light on the great table-land of Mexico, now traversed by the Mexican Central and other railroads. Also, see the General Note on the Geology of the Far West.

In Mexico the altitudes are an interesting study. At the United States and Mexican boundary the lowest depression of the great table-land occurs, but even that is nearly 4,000 feet above the sea. North of this it ascends again even in the valley to 7,000 feet, and near the 49th parallel it is again depressed. South of the boundary line the plateau rises rapidly to the table-land of Mexico, where the mountains assume a loftier and more rugged and diversified appearance than on the Texas side. In the more northern portions of Mexico the deposits in the valleys seem to be Tertiary, and farther south they are probably the same, and from the prevalence of volcanic deposits portions of them may be metamorphosed. We have no reports of the Cretaceous. The mountains show surprising developments of Carboniferous limestones, and of Huronian and Laurentian formations. Probably they are an extension or repetition of the granitic, porphyritic, basaltic and other eruptive rocks, and of the Carboniferous limestones of our far Western States and Territories, and the latter of very great thickness. Any differences which Mexico may discover, will probably be such as the more recent and more extensive volcanic action, and an enlargement of some of the formations would produce. There is a boundless field for geologists in Mexico, the country is being made accessible by railroads, and there is a charm about the unknown which imparts an interest to that which, when known, may perhaps be neither interesting nor very important. At present there is surprisingly little generally known about the geology of Mexico, and this chapter is a first attempt in that direction. It is given as founded on imperfect observations.

The Great Mountain Table-Land of Mexico.—There is scarcely a point on the globe, says Humboldt, where the mountains exhibit so extraordinary a formation and magnitude as in Mexico. Switzerland is considered a very elevated country, but this opinion is merely founded on the aspect of a great number of summits perpetually covered with snow, and disposed in chains parallel to the great central chain. The summits of the Alps rise to 12,500 and 15,500 feet, while the neighboring plains are not more than 1,300 to 2,000 feet in height. The chain of mountains which forms the vast plain of Mexico is the same with that which, under the name of the Andes, runs through all South America; but the construction of this chain varies to the north and south of the equator. In the Southern Hemisphere the Cordillera is everywhere torn and interrupted by crevices like open furrows or transverse valleys. The elevated plains of Quito are not to be compared in extent with those of Mexico. In Peru the most elevated summits constitute the narrow crest of the Andes; but, in Mexico, as shown by the railroad altitudes, even the lowest valleys are from 4,000 to 6,000 feet high, and the general altitude of the whole country, except a narrow border on the Atlantic and Pacific coasts, is 7,000 to 8,000 feet, and upon this are disposed the high volcanic peaks, less colossal, it is true, than the Andes, but still 16,000 to 17,000 feet, and, taken together, there is no such mountain on the globe, taking into view its extension northward into the United States. Peru and New Grenada contain deep transverse valleys, but in Mexico carriages (or in our day railroad cars) roll on from Mexico to Santa Fe, a distance of 1,500 miles, at altitudes of from 4,000 to 8,000 feet. On the whole road there are few difficulties for art to surmount, so little is the table-land of Mexico interrupted by valleys.

The Volcanic Mountains. In the part of the great plain of Mexico between the capital and Vera Cruz, a group of mountains appears which rivals the most elevated summits of the new continent. It is enough to name four of these colossi: Popocatepetl, or Smoke Mountain, 17,716 feet; Iztaccihuatl, or White Woman, 15,700 feet; Citlaltépetl, or Orizaba, the Star Mountain, 17,371 feet, and Nahcampa-tepetl, or Perote, the Square Mountain, 13,414 feet high, and so called from the form of a small, porphyritic rock at the summit. Besides the four volcanic mountains mentioned, there are the Nevado de Toluca, the Volcan de Colima, and a modern one, the new Volcan de Jorullo. As a general statement we may say that the general level of the whole country being some 7,000 feet above the sea, these volcanic cones situated upon it rise 8,000 to 10,000 feet higher.

The few observations that have been made by geologists are not sufficient to found an opinion upon as to the formations composing the core or main body of this vast mountain chain, or whether it is uniform throughout. Carboniferous limestone forms the visible portion at many places, and is no doubt an important element in its structure. There are other mountains of basalt or trap; others are Laurentian and Huronian, and at Mexico and southward are the chains of remarkable extinct volcanoes.

J. M.

Mexican Railway.			Mexican Railway.— Continued.		
Ms.		Alt.	Ms.		Alt.
	Vera Cruz.			Puebla.*	
0	Vera Cruz. ¹	19 b. Loup Fork Mio.(?)			
9	Tejeria. ²	"	94	Maltrata. ⁶	{ The great volcano 25 miles to N. E. 17,368 feet. 5555
19	Purga.	"			
26	Soledad.	" 305	97	Bota.	{ Orizaba Mt. near on the N. " to N. E. 7924
39	Camaron.	"	107	Boca del Monte. ⁷	Orizaba Mt. to E. 7941
47	Paso del Macho.	"	111	Esperanza. ⁸	"
53	Atoyac. ³	Volcanic soil. 1813	126	San Andres.	" 7731
68	Cordoba. ⁴	" 2713	139	Ruconada.	
71	Fortin.	"			
82	Orizaba. ⁵	{ The great volcano 25 miles to N. E., 17,868 feet. 4023	150	San Marcos. ⁹	{ Malinche Mt. in view, 13,470 feet high.

* The road also passes through the States of Tlaxcala and Mexico, but the boundary lines on the railroad are not ascertained.

1. *Vera Cruz.* The coast region extending between the beach at Vera Cruz along the Mexican Railway to the entrance into the gorges of the high Cordillera at Atoyac, fifty miles, is a low, sandy and marshy plain.

The 19 b. Loup Fork Miocene, 2000 feet in thickness, has been proved over a territory six miles by eighteen, in the State of Hidalgo and the adjoining parts of Vera Cruz, north of this railroad, by Professor Edw. D. Cope, who visited the region, and obtained bones and teeth of Tertiary animals. Several thin beds of coal occur in it, with shales between, apparently composed of volcanic ash and beds of excellent clay.—*Am. Nat. Mag.*, 1885. It probably underlies this part of the railroad. (See Note 16, by Dr. H. M. Chance, as to the coal beds at Jimulco.)

2. *Jalapa.* There is a branch railroad from Vera Cruz to Jalapa, and the table land and mountains at that place are reported to be principally limestone, doubtless the same with the Carboniferous limestone on the Mexican Central Railroad. There are many marble quarries, and some sandstone or quartzite.

3. *Atoyac.* The Cordillera presents an abrupt dark-green front of lofty mountains, above which towers the snow-capped Orizaba. The railway enters the highlands through the narrow and very picturesque pass of the Atoyac, and the scenery changes. In appalling curves we wind our way upwards through groves, along fearful chasms and slopes covered with the most luxuriant vegetation of the tropics. It is the landscape of the tropics, resting, as it were, on the Southern Alps, where they descend towards the plains of Lombardy. The summit of Orizaba rises above the glorious landscape of this wonderful region, like a cone of molten silver, in a cloudless sky. A. F. B.

4. *Cordoba.* Much of the superficial formations of this part of Mexico must necessarily be of volcanic origin. The plains and valleys in many places owe their present topography and physical basis to the wasting of the high volcanoes, whose ruins and debris constitute the soil, being volcanic detritus or sand. These masses of volcanic debris thin out as they spread eastward to a fertile layer of black volcanic soil of a sandy appearance, reaching nearly to the eastern brow of the table land at the Rio Atoyac. A. F. B.

5. *Orizaba.* Here the giant, of which glimpses were before obtained, bursts out into full view. The railroad at this city is 4,023 feet above tide, and the mountain 17,368 feet, and is twenty-five English miles distant to the N. N. E. A. F. B.

6. *Maltrata.* From Orizaba, the ascent by the road increases in steepness, and the scenery grows correspondingly wilder. The graceful palms gradually disappear, and beyond Maltrata the rise becomes extremely rapid. We are left in doubt as to which should be most admired—the sublime grandeur of nature, or the remarkable efforts of man to improve every chance, every inch almost, for establishing safe, rapid transit.

7. *Boca del Monte.* We pass through tunnel after tunnel, until at last Boca del Monte is reached. The air blows cool, even chilly; dark pines cover the mountain sides, and on our right towers, in close proximity, the summit of the Volcano of Orizaba. Less than nine hours have carried us one hundred and seven English miles by the railroad, but a horizontal basis of less than fifty miles; and in altitude through three zones, representing a vertical stratum of 8,000 feet. We have passed through a series of changes and contrasts in vegetation and climate of the most striking kind, and perfectly characteristic of Mexico. A. F. B.

8. *Esperanza.* The region through which the road passes in the vicinity of Esperanza, is a cold, rather barren looking highland, without any of the wildly picturesque scenery of the lower mountains; but the change is so sudden, that its very bleakness, with enormous prickly pears, dwarfish and ill-shapen palms, and tall *maquey* plants as types of vegetation, and the gigantic pyramid of Orizaba towering in full view to the east, has the effect of a successfully performed change in theatrical scenery. A. F. B.

9. *San Marcos.* A downward grade is struck beyond Esperanza, the highest point is passed at Guadalupe, and then the insensible and gradual decline to the central basin of Mexico begins. More and more the isolated peak of Malinche or Perote becomes prominent above the surrounding landscape. It is 13,470 feet (English) above sea level.

10. *Huamantla.* Beyond Huamantla the traveler is treated to a change in scenery again, and one of a very peculiar nature. Two remarkable sights burst into view almost simultaneously; the two great volcanic peaks of Mexico looming up like immense monuments. The most northerly,

* Archaeological Tour in Mexico.

Mexican Railway.— Continued.			Ferrocarril Central Mexicano, or Mexican Central Railroad.		
Ms.		Alt.	Ms.		Alt.
161	Huamantla. ¹⁰	The two greatest volcanoes come in view to E. and continue so to city of Mexico, to E., S. W., S. and S. E. Vol., and recent.		Dist. Federal.	
177	Apizaco. 7913			0 Mexico. ¹²	20. Quaternary. 7349
186	Guadalupe. 8883			7 Tlalnepantla.	" 7382
193	Soltepec.			11 Barrientos.	" 7541
206	Apam.	"		13 Lecheria.	" 7392
215	Irolo.			17 Cuautitlan.	" 7390
221	Ometusco.			22 Teoloyucan.	" 7392
225	La Palma.			29 Huehuetoca.	" 7410
229	Otumba. ¹⁰	"		33 Nochistongo.	" 7378
236	San Juan Teotihuacan.			Hidalgo.	
243	Tepexpan.			39 El Salto.	" 7095
263	Mexico. ¹¹			50 Tula.	" 6650
		20. Quat., and recent.		58 San Antonio.	Lauren. or Huro. 7175

Yzac-tepetl, or White Woman, commonly called the Sierra Nevada, presents a serrated ridge covered with perpetual snow, and resting on a broad platform, which very gradually descends into dark forests. It has three summits; the northern, the highest, is 15,862 feet. While this mountain is lower than Popocatepetl, it is much more massive, its base being twice as long. From the west its long, icy crest appears, strikingly like a woman in her last repose, in a white shroud, lying on her back upon a steep-sided platform. The other, Popocatepetl, or Smoke Mountain, lies south of the former, and therefore at a greater distance from the railroad. It appears as a perfect cone, slightly truncated, or rather with a cup-shaped summit. This concavity is the line of the crater here visible lengthwise, this part of the wall having fallen in, in the year 1864, whereas from Puebla it disappears, the top of the mountain rising above it to a sharp point. The height of Popocatepetl is 17,682 feet, being 314 feet higher than Orizaba. It thus appears to be the highest point of Mexico and of North America. The crater of Popocatepetl is a valuable mine of native sulphur. Its vast cup has a diameter of half an English mile, with such precipitous sides that it is considered impossible to descend into it, unless by means of a rope and crane.

The skeleton or frame of the mountain is formed of dark porphyritic and basaltic rocks, while its ribs and protuberances are covered over and smoothed down by an enormous deposit of volcanic scoria, to which is due the regular form of the peak. The rock of the other mountain is more compact, lighter colored, sometimes reddish, seldom amygdaloid, or spongy and very uniform. The limits of vegetation reach to about one-half the height of the mountain, a vast forest of pines of various species. Above this for two or three thousand feet the slopes are composed of dark gray or dirty red volcanic sand, with few crags and rocks protruding. Above this begins the ever-varying snow line, above which eternal snows cover the final slopes of the volcano, wherever they are not too steep to permit its lodging. Geologists state that Popocatepetl has had no eruption or emission of lava for centuries, but earthquake shocks occur every year in its vicinity, and the neighboring inhabitants are occasionally startled by dull sounds, like a plaintive moan uttered by a sleeping giant. History records the emission of smoke at various times. It is a tedious, but not in the least degree dangerous, journey to ascend it and stand on the brink of the crater, a yawning caldron in which the smoke of the three solfataras may be seen often mingled with the whirling clouds of a regular snow fall.

The two summits of Popocatepetl and Yzac-cihuatl are connected by an apparently eroded ridge, which presents itself like a deep gap, notwithstanding its mean altitude of 10,000 feet, so that they shoot up in bold relief like perfectly isolated masses. Their bases are hid by lower mountains running northward, and the railroad rounds the outer spur of these ranges in order to descend into the valley of Mexico from the northeast. We, therefore, see the volcanoes in the course of six hours, in going from Vera Cruz to Mexico, successively from the east, northeast, north, and finally upon reaching the city of Mexico from the northwest. It was while Cortés and his Spaniards were yet in the higher timbered regions of Popocatepetl, they enjoyed that first glorious view of the valley and the lakes which Prescott has so graphically described.

A. F. B.

11. *Mexico.* Few countries inspire so varied an interest as the valley of Mexico. It is the site of an ancient civilization of American people, and recollections the most affecting are associated with the city of Mexico and more ancient monuments, such as the Pyramids of Teotihuacan, dedicated to the sun and moon. Those who have studied the history of the conquest, delight to trace the military positions of Cortés and of the Tlascaltee army. The naturalist contemplates with interest the immense elevation of the Mexican table-land, and the extraordinary form of a chain of porphyritic and basaltic mountains which surround the valley like a circular wall. He perceives that the whole valley is at the bottom of a dried up lake. The basins of fresh and salt water which fill the centre of the plain, and the five marshes, are to the eye of the geologist the small remains of a great mass of water which formerly covered the whole valley.

HUMBOLDT.

The valley of Mexico, however beautiful it may appear under certain aspects of light, is in fact the remnant, not of a deep mountain-lake, but of an enormous marsh, formed by the accumulation, without natural outlet, of the waters collected on the tops and running down the slopes of the high ranges surrounding it. In the very centre of the Lake of Tezcoco flat barges or scows sometimes are in danger of grounding. The descriptions furnished by eye witnesses of the conquest by Cortés, of the beauty and fertility of the Mexican valley, need not surprise us. The effect from a distance, on a clear day, in the limpid and transparent sky of these altitudes, 7,349 English feet above sea-level, is enchanting. To the little band of Spaniards, traveling along the lake shore by the sides of the cultivated patches which the Indians had grouped around their pueblos, near the placid water, the first which they had seen since leaving the coast, the sight must have been charming. And when, through the filling up of the marsh, parts of it became transformed into sober corn fields, we need not wonder at the regret expressed by some respecting the change. It was the feeling which we ourselves experience at seeing the picturesque supplanted by the useful.

A. F. B.

Ferrocaril Central Mexicano, or Mexican Central Railroad.—Con.				Alt.	Ferrocaril Central Mexicano, or Mexican Central Railroad.—Con.				Alt.	
Mexico.					Mexico.					
70	Angeles.	7913	{ The geology, so far as known, is given in the notes.		229	Villalobos.	5728	{ The geology, as far as known, is given in the notes.		
74	Lena.	8109			238	Silao.	5828			
					249	Trinidad.	5964			
Hidalgo.						258	Leon.		5889	
76	Marquez.		{ Mountains supposed to be the same as Zacatecas.	"	268	Francisco.		"	5790	
81	Nopala.			"	7961	Jalisco.				
86	Danu.			"	7881	278	Pedrito.		"	5839
Mexico.						287	Loma.		6202	
94	Polotitlan. ¹⁴		"	7833	295	Lagos.		"	6121	
Hidalgo.						306	Serrano.		6613	
100	Cazadero.		"	7830	308	Los Salas.		"	6676	
Queretaro.						323	Santa Maria.		6051	
107	Palmillas.		{ Mountains supposed to be the same as Zacatecas.	"	334	Encarnacion.		"	6073	
118	San Juan del Rio.			"	7093	Aguaascalientes.				
127	Chintepec.			"	6261	350	Penuelas.		"	6164
134	Ahorcado.			"	6217	364	Aguaascalientes ¹³		"	6141
149	Hercules.			"	6289	382	Pabellon.		"	6261
153	Queretaro.			"	6049	388	Rincon de Romo		"	6321
Guanajuato.						400	Soledad.		6492	
164	Mariscal.			"	5949	Zacatecas.				
173	Apaseo.			"	5867	423	Summit.		"	7659
181	Celaya.			"	5798	432	Guadalupe. ¹⁴		"	7648
192	Guaje.		"	5768	439	Zacatecas. ¹⁵		For'y Hu. Schists.	8011	
207	Salamanca.		"	7708	447	Pimienta.		"	7566	
213	Chico.		"	5648	457	Calera.		"	7082	
219	Irapuato.		"	5645	474	Fresnillo. ²¹		"	6862	
			"	5655	484	Mendoza. ¹⁹		"	6900	

12. Very interesting human remains were found in January, 1884, some two and a half miles east of the city of Mexico, imbedded in a rock composed of silicified calcareous tufa. They are described and illustrated in the *American Naturalist*, for August, 1885.

12. *Mexico.* The valley of Mexico is eighteen and one-third leagues or fifty-five miles long, and twelve and a half leagues or thirty-seven miles in breadth. The crest of the mountains which surround it like a circular wall, is most elevated on the southeast, where the great volcanoes La Puebla, Popocatepetl, and Iztaccihuatl bound the valley. The city is no longer built in the midst of a lake, connected with the continent merely by three dikes, owing to the diminution of water of the lake Tezcuco. Humboldt pronounced Mexico, undoubtedly one of the finest cities ever built by Europeans in either hemisphere, but much less from the grandeur and beauty of its structures, than from its uniform regularity, its extent and position, leaving a recollection of grandeur which he attributes to the majestic character of its situation and the surrounding scenery. The beautifully cultivated valley forms a singular contrast with the wild appearance of the naked mountains which enclose it, among which the three famous volcanoes above named, with their enormous cones covered with perpetual snow, are the most distinguished.

14. *Guadalupe.* Dr. H. M. Chance, mining engineer, and lately an assistant on the second Geological Survey of Pennsylvania, who has been over this road, describes the plateau on which it is built as resembling to the traveler a flat valley, for mountains are seen on both sides of the railroad. But the chains, upon close examination, are seen to be simply a series of ranges, broken at many points. The flat plateau seems to have been formed by Tertiary (?) deposits, filling in what were formerly deep valleys between these mountain ranges, thus forming a network of level connected valleys, the Tertiary deposits filling them up above the lower connecting ridges, leaving them in the condition of half buried mountains. This description by Dr. Chance is probably as true as it is picturesque.

Between Zacatecas and the City of Mexico, Dr. Chance had less opportunity of examining the geology than at Zacatecas, but he thought the mountains on this part of the route are Laurentian or Huronian, consisting of granites, porphyry, etc., and that the plateau or apparent valleys are Tertiary or Quaternary. The mountains nearer Mexico are partly volcanic, and at some points north also volcanic deposits are seen. These lava beds generally lie west of the railroad and form "buttes" or flat top mountains, the lava beds protecting the soft Tertiary deposits from erosion. (See Note 15.)

15. *Zacatecas.* In the Zacatecas mining region an entirely different series of rocks from those to the northward is seen, apparently Huronian schists, with porphyry and Laurentian granites. This same series also occurs all along the range extending northwest, and lying, as at Chihuahua, twenty to one hundred miles west of the railroad. It probably also comes up in some of the ranges east of the railroad.

H. M. C.

16. *Jimulco.* The coal at Jimulco occurs in the plateau Tertiary deposits, and is apparently a lignitic bed of fluvi-marine origin. The bed opened in 1885 was too largely mixed with clay, etc. to be of any commercial value. See Note 1. Dr. Chance examined the mountains only at Jimulco, and found them to consist of an enormously thick series of limestone, partly metamorphosed, and probably of Upper Carboniferous age.

Ferrocarril Central Mexicano, or Mexican Central Railroad.—Con.			Ferrocarril Central Mexicano, or Mexican Central Railroad.—Con.		
Ms.		Alt.	Ms.		Alt.
493	Gutierrez.	Huronian Schists.	844	Dolores.	Valley 20 ms wide
507	Canitas.	"	853	Jimenez.	Mt. l. s. to south.
515	Cedro.	"	865	La Reforma.	"
528	La Colorada.	"	877	Diaz.	"
544	Pacheco.	"	889	Bustamante.	"
556	Guzman.	"	898	Santa Rosalia.	{ Hills of Amigdaloid
568	Gonzalez.	"			Basalt.
581	Camacho.	"	908	La Cruz.	{ Same wide val. run-
	Coahuila.	{ The main chain of the mountains is limestone.			ning N.E. & S.W.
595	San Isidoro.		921	Concho.	"
609	Symon.		931	Saucillo.	{ Limestone instead of the prevailing porphyry.
624	La Mancha.		941	Las Delicias.	"
637	Calvo.		945	Ortiz. ¹⁹	"
652	Peralta.		960	Bachimba.	"
662	Jimulco. ¹⁶	{ Mountains of enormously thick beds of Up. Carbon.	971	Horcasitas.	{ Narrow pass 6 miles long and 1 mile wide.
671	Jalisco.				"
	Durango.		985	Mapula.	"
680	Picardias	"	999	Chihuahua. ²⁰	See Note.
	Coahuila.		1014	Sacramento	{ Mountains, igneous rocks, porphyritic and trachytic, red, blue, white and gray.
695	Matamoros.	"	1023	Torreón.	
	Durango		1030	Sauz.	
709	Lerdo.	"	1043	Encinillas.	
720	Noe.	"	1051	Agua Nueva.	
732	Mapimi. ¹⁷	{ Note on the valleys	1060	Laguna.	
747	Peron. ¹⁸		1072	Puerto.	
761	Conejos. ¹⁸		1085	Gallejo.	
775	Yermo.		1103	Chivatito.	
787	Saez.		1112	Montezuma.	
	Chihuahua.	{ The main chain of the mountains is limestone, W.	1120	Las Minas.	
798	Zavalza.		1129	Ojocaliente. ²¹	
807	Escalon.		1136	Carmen.	
819	Rellano.		1150	San Jose.	
832	Corralitos.				Porphyritic rocks

17. *Mapimi*, lies in an eastern corner of the valley, surrounded by high mountains, in which silver mines are worked. Five miles south of it the Bolson de Mapimi begins, beyond a cañon, a very large open level valley, like a pouch or pocket, whence the name. A steep high limestone mountain on the east, and another chain to the left.

18. *Peron* and *Conejos*. This whole country is one large network of encased valleys, connected with each other by good mountain passes and defiles. Some of the mountains are compact limestone.

19. *Mendoza*. From the topographical appearance of the mountains and the natural escarpments seen all along the road for three hundred miles from above Chihuahua, to within fifty miles of Zacatecas, Dr. Chance thinks the mountain rocks to be of similar character throughout this distance to those at Jimulco, namely, a very heavy formation of metamorphic Upper Carboniferous limestone.

20. *Chihuahua* was settled in 1691, and has a beautiful situation at a circle of mountains opening to the south, with its churches and steeples, flat-roofed and commodious houses, its aqueducts and evergreen alameda. The rocks about Chihuahua, and at a point twenty miles northward, are porphyritic and trachytic, red, blue, white and gray.

The Mountains West of Chihuahua. Dr. Wislizenus was, during the Mexican war, detained six months a prisoner at Corihuniachi, in the Sierra Madre Mountains, about ninety miles west of Chihuahua. The place is 3,275 feet above the sea, and the highest peak of the chain of mountains, directly above the place, called the Bufo, a prominent landmark, is 7,918 feet. This is in the very heart of the Sierra Madre, and there were some renowned silver mines there, all found in the porphyritic rocks, the prevailing formation in this part of the country. He reports the geology of the country as quite uniform, and although he roamed in hunting for months in that vicinity over the Sierra Madre, which occupies the whole western portion of the State of Chihuahua, the connecting link between the Rocky Mountains of the north and the Andes of the south, he observed no other formations than porphyritic, except stratified limestone. These mountains contain old mines of silver, gold, lead, iron and tin, which were celebrated in their day.

21. *Fresnillo.* *General Aspect of the Country.* From a short distance south of El Paso nearly to Zacatecas, some seven hundred miles, the plateau on which the railroad is built is (in 1885) little better than a desert. The grass is generally scattered and bunched, and there is very little grass to be seen at all, the principal vegetation being cactus and scrubby mesquite, and there is an almost

Ferrocaril Central Mexicano, or Mexican Central Railroad.— <i>Con.</i>			Mexican National Railway. (Northern General Division.)†		
Ms.		Alt.	Ms.		Alt.
1165	Rancheria. ²²	{ Amygdaloid basalt, Mt. with l. s. 4200		Nuevo Leon.	
1176	Candelaria.	{ Granite and porphyritic Mts. 4397	0	Laredo.‡	19 a. Eocene. 806
1183	Los Mendanos.	Chiefly limestone. 4259	1	Nuevo Laredo.	"
1194	Samalayuca. ²³	{ Some granite & 4181	23	Jarita.	"
1204	Tierra Blanca.	{ porphyritic. 4145	49	Rodriguez. ²⁵	{ 19 c. Pliocene, or
1213	Mesa.	{ Limestone, 50 3960	76	Lampazos.	{ 20. Quaternary.
1224	Paso del Norte.	{ miles. 3717	109	Bustamante. ²⁶	" Mt. granite.
	El Paso. ²⁴		111	Villaldame.	"
			128	Palo Blanco.	"
			151	Salinas.	"
			163	Topo.	"
			172	Monterey. ²⁷	Up. Carb. l. s. 1626
			174	Gonzalitos.	"
			176	San Geronimo.	"
			173	Leona.	"
			180	Santa Catarin.	"
			193	Carcia.	"
				Cohahuila.	
			209	Rinconada.	" 3381
			215	Los Muertos.	"
			222	Ojo Caliente.	"
			226	Santa Maria.	"
			240	Santillo.	" 3242
			246	Buena Vista.	"
			279	Encarnacion.	"
			323	El Salado.	" 6104
Mexican National Railway					
(Southern General Division.)					
0	Mexico.	7347			
4	Tacuba.	7397			
9	Rio Hondo.	7550			
24	Cima. [*]	(Summit.) 9974			
32	Jajalpa.	" 8872			
37	Lerma.	" 8456			
45	Toluca.	" 8653			
69	Ixtlahuaca.	" 8423			
98	El Oro.	" 8344			
139	Maravatio.	" 6612			
178	Acambaro.	" 6084			
235	Moretia.	" 6202			

* The highest railroad point in Mexico.

† The altitudes of the places on this division are barometrical, taken by Dr. Wislizenus before the railroad was built.

‡ See Note 4 in Texas chapter.

entire absence of trees. But wherever the road approaches one of the principal water courses the scene changes. Irrigating ditches are seen on both sides of the stream, which is fringed as are the ditches by trees. These spots are as oases in a desert, and the land is apparently very fertile. C.

22. *Rancheria.* A porous, black-looking basaltic rock known as amygdaloidal basalt is very common throughout the whole of Mexico. Below it, in New Mexico and at El Paso, is a compact quartzose ferruginous sandstone, appearing as if changed by volcanic action. W.

23. *Samalayuca.* After leaving El Paso, Texas, or Paso del Norte, Mexico, to the west is a mountain chain, and to the east the receding valley of the Rio del Norte, from which, in going south, a high chain of mountains soon separate you, the road passing over a wide sandy plain covered with mesquite and similar shrubbery, and then runs for many miles through sand hills or "dunes," that are apparently of recent age. These sand hills similar to those in Texas, are an immense field of steep sandy ridges, without shrubs or vegetation of any kind, looking like a piece of Arabian desert transplanted into this plain, or like the bottom of the sea uplifted from the deep.

24. *Paso del Norte and El Paso.* See Notes 12, 13, 16, and 17 in Texas chapter.

25. Dr. Persifer Frazer, who passed over this road says, the valley traversed by it is a calcareous formation, much crushed and altered, which is clearly newer than the Upper Carboniferous mountains between which it lies. It may be 19 c. Pliocene or that and Quaternary, but no fossils have yet been found, and it may be 19 b. Loup Fork Miocene.

26. The Caudela Mountain is granite, also the Panuco, and a spur of the former reaching towards and near Bustamante. They protrude from the Upper Carboniferous. There is a large trap mass about seven miles northeast of Caldera. P. F.

27. The limestone mountains on this road are reported, by those who have seen them both, to be similar to those on the Mexican Central (See Notes 16 and 19.) It forms steep, often rugged, mountains, rising on an average 2,000 feet above the plain. It is metalliferous, containing silver and lead mines, and has all the appearance of the limestone found at El Paso and Chihuahua, but as yet we have no report of the discovery here of any fossils.

28. *Aguascalientes.* Here are famous hot springs, as indicated by the name. The place is a celebrated resort for invalids, and one of the cleanest provincial towns in Mexico. Population reported 20,000. H. M. C.

There are several other railroads in Mexico, but as yet I have learned nothing in regard to their geology. J. M.

INDEX OF RAILROADS.

N. B.—Branches, or minor roads, will generally be found under the name of the main or controlling line. The latest names, owing to the constant changes, can not always be given, but in some instances roads, given in the body of the book under an old name, will be found indexed under the new, as well as the old. The Guide is in itself an Index, and this Index is only an additional help to the traveler.

-
- | | |
|--|---|
| <p>Aberdeen, Bismark and N. W., 256.
 Addison and Northern Penna., 171.
 Adirondack, 118.
 Alabama Central, 881.
 Alabama great Southern, 379.
 Albert, 57.
 Allegheny Valley, 168.
 Annapolis and Elk Ridge, 332.
 Anniston and Atlantic, 382.
 Arkansas Midland, 406.
 Arkansas Valley, 407.
 Ashley River, 369.
 Ashtabula and Pittsburgh: Pa., 169; O., 178.
 Ashuelot, 91.
 Ashville and Spartansburg: N. C., 367; S. C., 369.
 Atchinson, Topeka and Sante Fe: Kan., 285; Col., 290; N. M., 290.
 Atlanta and Charlotte, 369.
 Atlanta and West Point, 375.
 Atlantic and North Carolina, 368.
 Atlantic and Pacific: Mo., 271; N. M., 323; Ariz., 328; Indian Ter., 408.
 Atlantic and Western, 394.
 Atlantic, Tenn., and Ohio, 368.
 Augusta and Knoxville, 369.</p> <p>Baltimore and Delaware Bay, 331.
 Baltimore and Ohio: Pa., 169; O., 178, 183, 185; Ind., 198; Ill., 209; Del., 329; Md., 332; W. Va., 340; Va., 353, 363.
 Baltimore and Potomac: Md., 332, Va., 359.
 Bangor and Katahdin, I. W., 97.
 Bangor and Piscataqua, 88.
 Bangor and Portland, 171.
 Bath and Hammondsport, 128.
 Barclay, 162.
 Barnwell, 373.
 Bay of Quinte, 61.
 Bedford and Bloomfield, 205.
 Beech Creek, Clearfield and S. W., 171.
 Bellaire, Zanesville and Cincinnati, 178.
 Bells Gap, 172.
 Bennington and Rutland, 93.
 Blue Ridge, 371.
 Boston and Albany: Mass., 104; N.Y., 134
 Boston and Lowell: N. H., 89; Vt., 93; Mass., 101.
 Boston and Maine: Can., 62; Me., 89; N.H., 89; Vt., 93; Mass., 99.
 Boston and N. Y. Air Line, 97.
 Boston and Providence, 103.
 Boston, Barre and Gardner, 105.</p> | <p>Boston Revere, Beach and Lynn, 101.
 Bound Brook: N. J., 144; Pa., 165.
 Bradford, Bordell and Kinzua, 172.
 Bradford, Eldred and Cuba, 172.
 Brighthope, 359.
 Brunswick and Albany, 374.
 Buffalo, N. Y. and Phila., (see Western N. Y. and Pa.): N. Y., 129; Pa., 166.
 Buffalo, Rochester and Pittsburgh: N. Y., 128; Pa., 173.
 Burlington and Mo. River: Kan., 284; Neb., 293; Col., 308.
 Burlington and Northwestern, 245.
 Burlington and Western, 245.
 Burlington, Cedar Rapids and N., 243.
 Cairo, Vicennes and Chicago, 213.
 California Pacific, 325.
 California, Pacific and Northern, 325.
 California Southern, 328.
 Cambridge and Seaford, 331.
 Camden and Atlantic, 148.
 Canada Atlantic, 68.
 Canadian Pacific, 62, 70, 80.
 Canada Southern, 65.
 Cape Fear and Yadkin: N.C., 367; S.C., 373.
 Cape Girardeau South Western, 273.
 Carolina Central, 367.
 Catsauqua and Fogelsville, 172.
 Catskill and Mt. Cairo, 136.
 Central Iowa: Ill., 220; Ia., 248.
 Central Ontario, 63.
 Central of N. J., 143, 144, 148, 149.
 Central Ohio, 178.
 Central Pacific, (see Southern Pacific): Nev., 310; Cal., 319, 326; Ariz., 322.
 Central R. R. of Georgia: S. C., 369; Ga., 374, Ala., 382.
 Central R. R. of S. Carolina, 369.
 Central Vermont, Can., 60; Vt., 92.
 Conn., 96; Mass., 106; N. Y., 136.
 Central Washington, 265.
 Charleston and Savannah: S. C., 369, Ga., 374.
 Charlotte, Columbia and Augusta: N. C., 368; S. C., 370.
 Chateaugay, 118.
 Chatham Branch, 57.
 Chatteroi, 399.
 Cheraw and Chester, 370.
 Cheraw and Darlington, 370.
 Cheraw and Salisbury, 370.
 Cheraw and Wadesboro, 368.
 Cherokee R. R., 376.</p> |
|--|---|

- Chesapeake and Ohio: W. Va., 843, 855; Va., 858, 859; Ky., 897, 851.
 Chesapeake, Ohio and S. W.: Ky., 898; Tenn., 401.
 Chesire, 91.
 Chester and Lenoir: N. C., 868; S. C., 870.
 Chicago and Alton: Ill., 212; Mo., 271.
 Chicago and Atlantic: O., 179; Ind., 204.
 Chicago and Canada Southern, 195.
 Chicago and Eastern Ill.: Ind., 204; Ill., 214.
 Chicago and Evanston, 219.
 Chicago and Grand Trunk: Mich., 195; Ind., 205.
 Chicago and Great Southern, 206.
 Chicago and Iowa: Ill., 211, 219.
 Chicago and Northwestern: Mich., 195, 197; Ill., 214; Wis., 228; Ia., 287; Minn., 247; Dak., 254.
 Chicago and West Michigan, 194.
 Chicago, Burlington and Kansas City: Ia., 241; Mo., 272.
 Chicago, Burlington and Quincy: Ill., 210; Ia., 240; Mo., 278.
 Chicago, Kansas and Nebraska, 282.
 Chicago, Milwaukee and St. Paul: Ill., 216; Wis., 226; Ia., 284; Minn., 246, 249; Dak., 253.
 Chicago, Rock Island and Pacific: Ill., 212; Ia., 239, 242; Mo., 270; Kan., 282.
 Chicago, St. Louis and New Orleans, 387.
 Chicago, St. Louis and Pittsburgh: O., 179; Ind., 199.
 Chicago, St. Paul, Minneapolis and Omaha: Wis., 226; Ia., 242; Minn., 247; Dak., 255; Neb., 296.
 Cincinnati and Eastern, 179.
 Cincinnati and Muskingum Valley, 179.
 Cincinnati, Hamilton and Dayton, 179.
 Cincinnati, Hamilton and Indianapolis: O., 179; Ind., 201.
 Cincinnati, Indianapolis, St. Louis and Chicago, 217.
 Cincinnati, LaFayette and Chicago, 200.
 Cincinnati, New Orleans and Texas Pacific: Miss., 388; La., 390; Ky., 398; Tenn., 405.
 Cincinnati, Richmond and Chicago, 179.
 Cincinnati, Richmond and Fort Wayne, 202.
 Cincinnati, Van Wert and Michigan, 179.
 Cincinnati, Wabash and Michigan, 203.
 Clarksburg and Weston, 346.
 Cleveland and Pittsburgh, 180.
 Cleveland, Akron and Columbus, 180.
 Cleveland, Columbus, Cincinnati and Indianapolis: O., 179; Ind., 200.
 Cleveland, Loraine and Wheeling, 180.
 Cleveland, Youngstown and Pittsburgh, 181.
 Coburg, Peterborough and Mamora, 66.
 Columbia and Greenville, 370.
 Columbia and Puget Sound, 265.
 Columbus and Cincinnati Midland, 181.
 Columbus and Eastern, 181.
 Columbus and Xenia, 181.
 Columbus, Hocking Valley and Toledo, 181.
 Concord and Portsmouth, 91.
 Connecticut River: N. H., 91; Mass., 107.
 Connoton Valley, 182.
 Corning, Cowanesque and Antrim, 170.
 Crown Point, 118.
 Cumberland and Pennsylvania, 384.
 Cumberland and Maurice River, 149.
 Cumberland Valley, 170.
 Danbury and Norwalk, 95.
 Danville, Mocksville and S. W., 868.
 Danville, Olney and Ohio River, 220.
 Dayton and Michigan, 182.
 Dayton and Union, 182.
 Delaware and Bound Brook, 144.
 Delaware and Chesapeake, 331.
 Delaware and Hudson Canal Co.: N. Y., 116; Pa., 171.
 Delaware, Lackawanna and Western: N. Y., 120; N. J., 142; Pa., 160.
 Delaware, Maryland and Virginia, 380.
 Delaware River, 149.
 Delaware Railway, 330.
 Denver and Rio Grande: Col., 804· U., 318.
 Denver, Texas and Gulf, 308.
 Denver, Utah and Pacific, 308.
 Des Moines and Fort Dodge, 242.
 Des Moines, Osceola and Southern, 245.
 Detroit and Eel River, 200.
 Detroit, Grand Haven and Milw., 198.
 Detroit, Hillsdale and Southwestern, 194.
 Detroit, Lansing and Northern, 194.
 Detroit, Mackinaw and Marquette, 197.
 Dubuque and Dakota, 245.
 Duluth, South Shore and Atlantic, 196, 197.
 Dunkirk, Allegheny Valley and Pittsburgh: N. Y., 127; Pa., 167.
 East Alabama and Cincinnati, 382.
 East Broad Top, 170.
 Eastern, 99.
 Eastern Extension, 58.
 Easton and Amboy, 144.
 Eastern Kentucky, 399.
 East Tennessee, Virginia and Georgia: Ga., 374, 376; Ala., 381; Miss., 388; Tenn., 408.
 East Tennessee, Virginia and Georgia S. W., 404.
 East Tennessee and Western North Carolina: N. C., 368; Tenn., 403.
 Elberton Air Line, 377.
 Elk River, (W. Va.,) 850.
 Elmira, Cortland and Northern, 128.
 Erie and Pittsburgh, 168.
 Eureka and Palisade, 315.
 Eureka Springs, 407.
 Evansville and Terra Haute, 204.
 Evansville, Owensboro and Nashville, 400.

- Fairmount, Morgantown and Pittsburgh, 348.
 Fitchburg: Mass., 105; N. Y., 135.
 Flint and Pere Marquette, 193, 196.
 Florida Central and Peninsular, 392.
 Florida Southern, 393.
 Florida, Johnstown and Gloversville, 130.
 Fort Madison and Northwestern, 245.
 Fort Wayne and Jackson, 202.
 Fort Wayne, Muncie and Cincinnati, 203.
 Fort Worth and Denver City, 413.
 Freehold and New York, 147.
 Freemont, Elkhorn and Missouri Valley: S. Dak., 256; Neb., 296, 313; Wy., 313.
 Fulton Co., 220.
 Galveston, Harrisburg and San Antonio: La., 391; Tex., 411.
 Gauley River, (W. Va.)
 Geneva, Ithaca and Sayre, 122.
 Georgetown, 409.
 Georgetown and Lanes, 371.
 Georgia Pacific, 383.
 Georgia R. R., 375.
 Gettysburg and Harrisburg, 166.
 Grafton and Greenbrier, 346.
 Grand Gulf and Fort Gibson, 389.
 Grand Rapids and Indiana: Mich., 192; Ind., 202.
 Grand Rapids, Newaygo and L. S., 194.
 Grand Southern, 57.
 Grand Tower and Carbondale, 217.
 Grand Trunk: Can., 58, 62, 65; N. H., 89; Mich., 195, 197.
 Green Bay, Winona and St. Paul, 229.
 Green Pond Mine, 141.
 Greenwich and Johnsonville, 135.
 Greenwood, Laurens and Spartansburg, 373.
 Gulf, Colorado and Santa Fe, 412.
 Gulf, Western Texas and Pacific, 411.
 Halifax and Scotland Neck, 367.
 Hannibal and St. Joseph, 267.
 Hanover Jc., Hanover and Gettysburg, 170.
 Harrisburg and Potomac, 173.
 Hartford and Connecticut Western: Conn., 95; N. Y., 134.
 Havana Rantoul and Eastern, 221.
 Hot Springs, 406.
 Housatonic: Conn., 95; Mass., 107.
 Houston and Texas Central, 411.
 Houston, East and West Texas, 413.
 Huntingdon and Broad Top, 170.
 Illinois and St. Louis, 217.
 Illinois Central: Ill., 209, 221; Ia., 236; Miss., 387; La., 390; Ky., 400; Tenn., 402.
 Illinois Midland, 217.
 Indiana, Bloomington and Western: O., 182; Ind., 200, 205, 207; Ill., 217.
 Indiana, Illinois and Southern, 220.
 Indiana, Illinois and Iowa, 221.
 Indianapolis and St. Louis: Ind., 201; Ill., 220.
 Indianapolis, Cincinnati and LaFayette, 201.
 Indianapolis, Decatur and Springfield, 217.
 Intercolonial, 62.
 International, 66.
 International and Great Northern, 409.
 Iowa Central, see Central Iowa.
 Jacksonville and Atlantic, 394.
 Jacksonville, St. Augustine and Halifax River, 393.
 Jacksonville Southeastern, 217, 220.
 Jacksonville, Tampa and Key West, 394.
 Jamesville and Washington, 368.
 Jefferson, Madison and Indianapolis, 201.
 Kaaterskill, 136.
 Kankakee and Seneca, 219.
 Kansas City, Fort Scott and Memphis: Mo., 273; Kan., 284; Ark., 407.
 Kansas City, Wyandotte and N. W., 283.
 Kansas City, St. Joseph and Council Bluffs: Ia., 242; Mo., 272.
 Kentucky and South Atlantic, 400.
 Kentucky Central, 399.
 Kentucky Union, 399.
 Kingston and Pembroke, 66.
 Knox and Lincoln, 88.
 Lackawanna and Pittsburgh, 130.
 Lake Erie and Western: O., 182; Ind., 207; Ill., 219.
 Lake Shore and Michigan Southern: N. Y., 128; Pa., 167; O., 182; Mich., 191, 194; Ind., 198, 202; Ill., 217.
 Laurens, 371.
 Lawrence and S. W., 278.
 Lehigh and Hudson River: N. Y., 130; N. J., 145.
 Lehigh and Lackawanna, 173.
 Lehigh Valley: N. Y., 122; N. J., 144; Pa., 161.
 Ligonier Valley, 172.
 Litchfield, Carrolton and Western, 220.
 Little Kanawha River, 350.
 Little Miami, 183.
 Little Rock and Fort Smith, 406.
 Long Island, 136.
 Los Angeles and San Diego, 328.
 Louisiana and Texas, 391.
 Louisville and Great Southern, 378.
 Louisville and Nashville: Ind., 204; Ill., 218; Ala., 378, 381; Miss., 389; La., 390; Fla., 392; Ky., 396, 400; Tenn., 402.
 Louisville, Evansville and St. Louis: Ind., 203, 206; Ill., 219.
 Louisville, New Albany and Chicago, 203, 205.

- Louisville, New Orleans and Texas: Miss., 889; La., 891.
 Maine Central: Me., 87, 89; N. H., 89.
 Manchester and Laurence, 91.
 Manchester and North Weare, 91.
 Manitoba and N. W. of Canada, 77.
 Manitoba Southwestern, 78.
 Marietta and Cincinnati, 183.
 Marietta, Pittsburgh and Cleveland, 183.
 Marquette, Houghton and Ontonagon, 196.
 Maryland Central, 835.
 Meadville and Linesville, 172.
 Memphis and Charleston, 880.
 Memphis and Little Rock, 406.
 Mexican, 416.
 Mexican Central, 417.
 Mexican National: Tex., 418; Mex., 420.
 Michigan and Ohio, 196.
 Michigan Central: N. Y., 129; Mich., 190, 195, 197; Ind., 198; Ill., 217.
 Midland North Carolina, 868.
 Milton and Sutherland, 868.
 Milwaukee and Northern, 230.
 Milwaukee, Lake Shore and Western, 230.
 Minneapolis and St. Louis: Ia., 245; Minn., 248.
 Minneapolis, Sault Ste. Marie and Atlantic, 232.
 Mississippi and Tennessee, 887.
 Missouri, Iowa and Nebraska, 268.
 Missouri, Kansas and Texas—now
 Missouri Pacific: Mo., 268; Kan., 278, 279; Neb., 296; La., 891; Ark., 406; I. T., 408; Tex., 418.
 Mobile and Alabama Grand Trunk, 381.
 Mobile and Girard, 381.
 Mobile and Montgomery, 381.
 Mobile and Ohio: Ala., 381; Miss., 887; Ky., 400; Tenn., 402.
 Monadnock, 91.
 Monongahela River, 348.
 Montana Central, 264.
 Montgomery and Eufaula, 381.
 Montgomery and Southern, 382.
 Montour, 174.
 Montpelier and Wells, 91.
 Montrose, 162.
 Morgan's Louisiana and Texas, 891.
 Mount Alto, 173.
 Nashville and Chattanooga, 380.
 Nashville and Decatur, 380.
 Nashville, Chattanooga and St. Louis, 403.
 Natchez, Jackson and Columbus, 387.
 Naugatuck, 95.
 Nebraska: Kan., 284; Neb., 293.
 Nevada County, 324.
 Newark and Delaware City, 329.
 Newark and Patterson, 141.
 Newark and New York, 143.
 New Brunswick, 55.
 Newburg, Dutchess and Columbus, 134.
 New Canaan, 95.
 New Haven and North Hampton: Conn., 97; Mass., 106.
 New Jersey and New York: N. Y., 127; N. J., 141.
 New Jersey Southern, 148.
 New London Northern, 106.
 New Orleans and Northeastern, 388.
 New York and Greenwood Lake, 142.
 New York and Long Branch, 147.
 New York and Massachusetts, 134.
 New York and New England: Conn., 96, Mass., 103; N. Y., 135.
 New York and Northern, 132.
 New York Central and Hudson River, 110, 132.
 New York, Chicago and St. Louis: N. Y., 128; O., 183; Ind., 206.
 New York, Lake Erie and Western: N. Y., 124; N. J., 141; Pa., 159.
 New York, New Haven and Hartford: Conn., 94, 95, 97; N. Y., 133.
 New York, Ontario and Western, 123.
 New York, Pennsylvania and Ohio: N. Y., 125; Pa., 160; O., 183.
 New York, Philadelphia and Norfolk, 331.
 New York, Pittsburgh and Chicago, 174.
 New York, Rutland and Montreal, 133.
 New York, Susquehanna and Western: N. Y., 130; N. J., 140; Pa., 173.
 New York, Texas and Mexican, 411.
 Norfolk and Western, 357.
 Norfolk Southern, 368.
 Northeastern, 371.
 Northeastern of Georgia, 376.
 Northern and Northwestern, 61.
 Northern of Canada, 66.
 Northern Central: N. Y., 121; Pa., 158; Md., 332.
 Northern of New Jersey, 140.
 Northern Pacific: Minn., 249, 258; Dak., 255, 258; Mon., 259; Id., 261; Wash., 262.
 Northern Pacific Coast, 325.
 Northshore, 60.
 Northwestern Ohio, 184.
 Ogdensburg and Lake Champlain, 136.
 Ohio and Mississippi: O., 184; Ind., 202, 206; Ill., 218.
 Ohio Central: O., 184; W. Va., 345.
 Ohio River, 345, 348.
 Ohio Southern, 184.
 Old Colony, 102.
 Olympia and Chehalis Valley, 265.
 Orange Belt, 393.
 Oregon and California, 316.
 Oregon Central, 317.
 Oregon Railway and Navigation Co.: Or., 262, 317; Wash., 285.
 Oxford and Henderson, 368.

- Pacific Coast, 328.
 Painesville and Youngstown, 185.
 Passumpsic: Can., 62; Vt., 98.
 Peachbottom, 166.
 Pennsylvania: N. J., 144; Pa., 152.
 Pennsylvania and Delaware, 329.
 Pennsylvania and N. Y. Canal Co., 122.
 Pensacola and Atlantic, 892.
 Peoria, Decatur and Evansville, 216.
 Perkiomen, 166.
 Petersburg, 368.
 Philadelphia and Atlantic City, 149.
 Philadelphia and Baltimore Central, 332.
 Philadelphia and Reading: N. J., 144; Pa., 162.
 Philadelphia, Newtown and New York, 173.
 Philadelphia, Wilmington and Baltimore: Pa., 166; Del., 329; Md., 382.
 Piedmont Air Line. See Richmond and Danville.
 Pittsburgh and Castle Shannon, 174.
 Pittsburgh and Lake Erie, 174.
 Pittsburgh and Western: Pa., 175; O., 185.
 Pittsburgh, Chartiers and Youghiogeny, 174.
 Pittsburgh, Cincinnati and St. Louis: Pa., 169; O., 181, 183, 185; Ind., 199; W. Va., 346.
 Pittsburgh, Ft. Wayne and Chicago: Pa., 168; O., 185; Ind., 198; Ill., 218.
 Pittsburgh, McKeesport and Yough., 174.
 Pomeroy and Newark, 155.
 Port Huron and Northwestern, 196.
 Portland and Ogdensburg, 89.
 Portland and Rochester, 88.
 Port Royal and Augusta, 371.
 Prince Edward Island, 56.
 Profile and Franconia Notch, 90.
 Providence and Worcester: Conn., 96; Mass., 104.
 Puget Sound, 265.
 Quebec and Lake St. John, 60.
 Quebec Central, 61.
 Queen Anne's, Kent and Townsend, 831.
 Quincy, Missouri and Pacific, 268.
 Raleigh and Augusta, 366.
 Raleigh and Gaston, 366.
 Richmond and Allegheny, 359.
 Richmond and Danville (Piedmont Air Line): Va., 355, 356, 358; N. C., 366; S. C., 369; Ga., 375, 377.
 Richmond, Fredericksburg and Potomac, 356.
 Richmond, York River and Chesapeake, 357.
 Rio Grande, 413.
 Rochester and Lake Ontario, 129.
 Rock Island and Mercer Co., 219.
 Rock Island and Peoria, 218, 219.
 Rocky Mt. of Montana, 262.
 Rome R. R., 376.
 Rome, Watertown and Ogdensburg, 118, 119.
 St. Croix and Penobscot, 97.
 St. Joseph and Western, 295.
 St. Louis, Alton and Terre Haute, 218.
 St. Louis and Cairo, 218.
 St. Louis and San Francisco: Mo., 271; Kan., 277; Ark., 407.
 St. Louis and Southeastern, 204.
 St. Louis Coal, 216.
 St. Louis, Creve Coeur and St. Charles, 273.
 St. Louis, Des Moines and Northern, 245.
 St. Louis, Hannibal and Keokuk, 273.
 St. Louis, Iron Mt. and Southern: Mo., 269, Ark., 407.
 St. Louis, Keokuk and Northwestern: Ia., 245; Mo., 272.
 St. Louis, Salem and Little Rock, 272.
 St. Louis, Vandalia, Terra Haute and Indianapolis: Ind., 201; Ill., 219.
 St. Paul and Duluth, 248.
 St. Paul, Minneapolis and Manitoba: Minn., 250; Dak., 254, 256; Mon., 264.
 St. Paul, Stillwater and Taylor's Falls, 251.
 Sacramento and Placerville, 326.
 Sandusky, Mansfield and Newark, 185.
 Saginaw Valley and St. Louis, 195.
 Sandy River, 97.
 Sanford and Indian River, 394.
 San Francisco and Northern Pacific, 324.
 San Pete Valley, 315.
 Saratoga and Champlain, 91.
 Savannah and Memphis, 382.
 Savannah, Florida and Western, 394.
 Savannah, Griffin and N. Alabama, 376.
 Scioto Valley, 185.
 Seaboard and Roanoke: Va., 357; N. C., 368.
 Seattle, Lake Shore and Eastern, 265.
 Selma and Gulf, 381.
 Selma, Marion and Memphis, 382.
 Selma, Rome and Dalton: Ga., 376; Ala., 379.
 Sharpsville, 174.
 Shenandoah Valley, 361.
 Shenango and Allegheny, 168.
 Shepang, 95.
 Silver Springs, Ocala and Gulf, 394.
 Sioux City and Pacific: Ia., 242; Neb., 296; Wy., 313.
 Skaneateles, 115.
 Somerset, 88.
 South and North Alabama, 378.
 South Carolina, 372.
 Southeastern, 62.
 Southern Pacific (see also Central Pacific): Or., 316, 317; Cal., 320, 325, 326; Ariz., 322; N. M., 323; La., 391; Tex., 411.
 South Florida, 394.

- South Pacific Coast, 327.
 Spartansburg, Union and Columbia, 372.
 Spokane and Palouse, 265.
 State Line and Sullivan, 162.
 Staten Island, 137.
 Stockton, Visalia and Copperopolis, 326.
 Stonington and Providence, 96.
 Straitsville, Somerset and Newark, 178.
 Stony Clove and Catskill, 136.
 Syracuse, Geneva and Corning, 122.
 Syracuse, Ontario and N. Y., 127.

 Tavares, Apopka and Gulf, 394.
 Tennessee Coal and Iron, 404.
 Terra Haute and Indianapolis, 207.
 Texas and Pacific, 410.
 Texas and St. Louis: Mo., 273; Ark., 407; Tex., 413.
 Tionesta Valley, 174.
 Toledo, Ann Arbor and Grand Trunk, 197.
 Toledo, Canada Southern and Detroit, 195.
 Toledo, Cincinnati and St. Louis: O., 186; Ill., 220.
 Toledo, Peoria and Western, 219.
 Tom's River and Waretown, 148.
 Tonawanda Valley and Cuba, 129.
 Tuckertown, 148.
 Troy and Boston, 135.
 Troy and Schenectady, 115.

 Ulster and Delaware, 130.
 Union Pacific: Kan., 274; Neb., 295; Col., 301; Wy., 310; Ut., 310; Id., 311; Mon., 312.
 University, 368.
 Utah and Nevada, 314.
 Utah Central, 314.
 Utica and Black River, 118.

 Valley, 186.
 Vicksburg and Brunswick, 382.
 Virginia and Truckee, 315.
 Virginia Midland, 355.

 Wabash, Chester and Western, 217.
 Wabash (Wabash, St. Louis and Pacific): O., 186; Ind., 200, 203; Ill., 214; Ia., 241; Mo., 267.
 Washington City, Va. Midland and Great Southern, 355.
 Washington, Ohio and Western, 358.
 Waterloo and Magog, 56.
 Waynesburg and Washington, 175.
 Western and Atlantic, 376.
 Western Counties, 57.
 Western Maryland: Pa., 170; Md., 333.
 Western N. Y. and Pennsylvania: N. Y., 129; Pa., 166.
 Western North Carolina, 366.
 Western of Alabama, 380.
 Western of Florida, 394.
 West Jersey, 149.
 Weston and Buckhannon, 346.
 West Shore: N. Y., 130; N. J., 140.
 West Virginia Central, 347, 349.
 West Virginia and Pittsburgh, 348.
 Wheeling and Lake Erie, 187.
 Whitfield and Jefferson, 91.
 Wicomico and Pocomoke, 331.
 Williamsport and North Branch, 172.
 Wilmington and Northern: Pa., 166; Del., 331.
 Wilmington and Weldon, 367, 368.
 Wilmington and Western, 331.
 Wilmington, Columbia and Augusta: N. C., 367; S. C., 373.
 Windsor and Annapolis, 54.
 Wisconsin Central, 231.
 Wisconsin, Iowa and Nebraska, 245.
 Woodstock, 93.
 Worcester, Nashua and Rochester: N. H., 91; Mass., 105.

 York and Peachbottom, 173.
 Youghiogheny, 175.







557.3 .M143 ed.2 C.1
An American geological railway
Stanford University Libraries



3 6105 032 265 402

